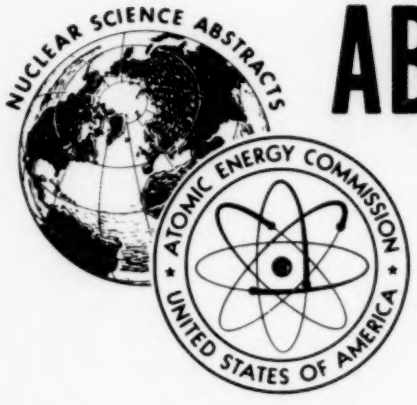
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 3

Abstracts 4788-7480

February 15, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 29, Number 3, February 15, 1974

NUCLEAR SCIENCE ABSTRACTS

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Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

4788 COMPREHENSIVE INORGANIC CHEMISTRY. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973). 1501p.

Separate abstracts were prepared for eleven of the fifteen chapters included in Volume 1. The remaining chapters review proton, protonic acid, and hydrogen bond; lithium and its compounds; silicon; and organic chemistry of metallic elements. (DHM)

For abstracts of individual chapters see: 4789, 4790, 4872, 4953–4955, 5421–5423, 5438, and 6066.

Analytical and Separations Chemistry

Refer also to abstracts 5245, 5247, 5590–5592, 5594–5596, 5598, 5600, 5607, 5608, and 7406.

4789 MONATOMIC GASES: PHYSICAL PROPERTIES AND PRODUCTION. Cockett, A. H.; Smith, K. C. (British Oxygen Co. Ltd., London). pp 139-209 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on the physical properties and production of the monatomic gases, helium, neon, argon, krypton, xenon, and radon. Topics considered include discovery; abundance; origins; isotopes; atomic structure; spectra; polarizability and refractive index; thermodynamic properties; velocity of sound; transport properties; properties of the liquids and solids; phase equilibria; uses; production; liquefaction; technical specifications, production data, storage, and distribution; techniques of purification and analysis; and separation of stable isotopes. (301 references) (DHM)

4790 BERYLLIUM. Everest, D. A. (National Physical Lab., Teddington, Eng.). pp 531-590 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on beryllium that includes discovery and history, occurrence and distribution, production and industrial use, nuclear properties, physical properties, chemistry and chemical properties, biological activity, and analytical chemistry. Consideration is also given to the chemistry of beryllium compounds and complexes. (154 references) (DHM)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 5213, 5227, 5272, 5380, 5725, and 6981.

4791 (CEA-CONF-2361) USE OF RADIOACTIVE TECHNIQUES FOR THE STUDY OF THE HOMOGENEITY OF THE DIFFUSION OF PHOSPHORUS AND FOR THE STUDY OF THE METALLIC IMPURITIES IN REAGENTS, WATER, AND ON THE SURFACE OF SILICON SLICES. Lafeuille, D.; Roche, D.; Gailliard, J. P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 8 Jan 1973. 12p. (In French). (CONF-720990-10). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semi conductors; Grenoble, France (27 Sep 1972).

Autoradiography constitutes a simple method of analysis for determining the nature of structural defects produced by diffusion operations. It enables local variations in the element diffused into a slice of material and from one slice of material to another to be established. Results obtained in the case of the diffusion of phosphorus into silicon are presented. In addition, irradiation analysis (brief duration irradiation in the liquid phase) permits metallic impurities to be determined in chemical reagents, solvents, and ionized water. This technique is applied to the cleaning of silicon slices. (FR)

4792 (CONF-720920-5) MERCURY CONTENT OF HAIR FROM NORMAL AND POISONED PERSONS. Al-Shahristani, H.; Al-Haddad, I. K. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.). Mar 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Several hundred samples of human head hair are analyzed to establish the range and variation of mercury concentration in "normal" people and in persons ingesting organic mercury compounds. Instrumental neutron activation analysis was used. The 77-keV line of ^{197}Hg was counted on a Ge(Li) detector. The pattern of concentration variation along hair is shown to be a more reliable criterion for hair individualization than average concentration values. The hair mercury content of "normal" people in uncontaminated and contaminated areas was from 0.1–4 and 1–12 ppM, respectively. People who ingested mercury compound but showed no symptoms had hair mercury concentrations from few ppM to 300 ppM. Mild symptoms appeared with 120–600 ppM hair mercury level; moderate with 200–800 ppM; and severe with 400–1600 ppM. There was no correlation with sex or age except that infants showed more severe symptoms than expected and people over 55 had mild or no symptoms with hair mercury level of 1000 ppM and higher. (auth)

4793 (IRI-133-73-8) COMPARATIVE STUDY ON THE INFLUENCE OF RESIN COATING ON THE TIN LEVELS IN CANNED FOOD. de Goeij, J. J. M.; Kroon, J. J. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1973. 13p. (CONF-730817-3). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973).

Rapid and sensitive neutron activation procedure based on ^{123m}Sn has been developed. This technique was used for comparing natural tin levels in food with the high levels resulting from canning. The natural levels were also compared with the levels in resin-coated cans. (LK)

4794 (IRI-133-73-9) ACTIVATION ANALYSIS TRACE-ELEMENT STUDIES OF DOVER SOLE LIVER AND MARINE SEDIMENTS. de Goeij, J. J. M.; Guinn, V. P.; Young, D. R.; Mearns, A. J. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1973. 22p. (CONF-730817-4). Dep. NTIS (U. S. Sales Only) $3.25.

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973).

Activation analysis was used to analyze samples of Dole sole liver and marine sediments for Sb, As, Hg, Se, Cr, Co, Cu, Fe, Mo, W, and Zn. (LK)

4795 (NP-19876) TRACE ELEMENTS IN IRAQI OILS AND THEIR RELATIONSHIP TO THE ORIGIN AND MIGRATION OF THESE OILS. Al-Shahristani, H.; Al-Attiya, M. J. (Iraq Atomic

Energy Commission, Baghdad. Nuclear Research Inst.). Mar 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

A study is made of the trace element composition of crude oils from almost all the producing formations of the Iraqi oil fields. A total of 13 trace elements were determined using neutron activation analysis techniques. These elements are Al, V, Cl, Ni, Mn, K, Zn, Ga, Na, As, Br, Hg, and Co. Their concentrations ranged from a few parts per billion (e.g., As and Ga) to several parts per million (e.g., V, Ni and Cl). The concentration range of elements such as Co, Zn, and As was less than tenfold, whereas others such as Hg varied from less than 0.05 to 72 ppM, i.e., 1500-fold. The vanadium and nickel content of an oil has a direct relationship with its history of migration and accumulation. In northern Iraq the results provide evidence for the vertical migration of oil in the Kirkuk and Ain Zalah oil fields. The bromine concentration generally follows the same pattern as vanadium and nickel in the northern fields but not in the south. The concentration of the metals Na, K, Al, and Mn is related to the variation in Cl concentration, indicating that they are perhaps present as chloride salts. Ga, As, Mn, and Co concentrations do not vary appreciably among the different oils. In general, the heavier the oil, the higher the arsenic content. Gallium is present in Kirkuk area oils at higher concentrations than in the other fields. Mercury was measured in oils from the Dai Hassan field, the Khurmala dome of Kirkuk, and the Upper Cretaceous reservior of Ain Zalah at relatively high concentrations. In the rest of the oils mercury was extremely low in concentration and generally below the detection level. (auth)

4796 (RISO-200) STUDIES ON SELENIUM IN PLANTS AND SOILS. Bisbjerg, B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972. 150p. Dep. NTIS (U. S. Sales Only) $9.50.

A description is given of studies of selenium in Danish soils and plants. An analytical survey showed that with the exception of the Cruciferae family most Danish agricultural crops have selenium concentrations below the minimum required for the production of healthy animals. The rare occurrence of selenium deficiency in Danish domestic animals is probably a result of supplements to rations of selenium-rich foodstuffs as oilcakes and fishmeal. The uptake in crops from selenium added as selenate or selenite to the soil was investigated as were the chemical forms and oxidation states of selenium in soils and plants. A procedure is described for determination of selenium in soils and plants by neutron activation analysis. Results obtained by this method are compared with results obtained by flourometric determination. The agreement is satisfactory for soil samples, whereas for kale the activation analysis yielded a somewhat higher result than did the fluorometric determination. (DE)

4797 (RISO-M-1633) ARSENIC IN STANDARD REFERENCE MATERIAL 1571 (ORCHARD LEAVES). Damsgaard, E.; Heydorn, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). 4 Jul 1973. 10p. (CONF-730729-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 3rd symposium on the recent development in neutron activation analysis; Cambridge, UK (2 Jul 1973).

Inability to attain the certified concentration of arsenic in National Bureau of Standards Reference Material 1571 prompted a detailed investigation of possible systematic errors in our method (1) for the determination of arsenic, manganese, and selenium in biological materials by neutron activation analysis. Possible shortcomings in analytical technique were scrutinized and followed by careful investigation of more fundamental errors from losses occurring before carrier addition, incomplete carrier exchange, and interfering elements. Results indicated that although our method was not entirely without systematic errors, their magnitude was insufficient to account for the discrepancy with the certified value. We are therefore led to conclude that the true concentration of arsenic in SRM 1571 Orchard Leaves is significantly lower than the 14 ± 2 ppM certified by the National Bureau of Standards (2). (DE)

4798 (T-743, pp 3.143-3.148) NEUTRON ACTIVATION ANALYSIS USING TRIGA. Byrne, A. R. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Neutron activation analysis with TRIGA MARK II is reported in the following areas: environmental research on mercury, impurities in analytical and supra-pure reagents, trace element determination in biological materials, trace elements in glass, and impurities in uranium dioxide. (DHM)

4799 DETERMINATION OF STOICHIOMETRY OF VANADIUM OXIDES BY 14-MeV NEUTRON ACTIVATION. Lievens, P.; Speecke, A.; Hoste, J. (Univ., Ghent). Anal. Chim. Acta; No. 67, 269-275(1973).

A method was developed for the determination of oxygen/vanadium ratios in vanadium oxides by 14-MeV neutron activation analysis by means of the reactions $^{51}V(n,p)^{51}Ti$ and $^{16}O(n,p)^{16}N$. A linear relationship between activity ratios and weight ratios of six mixtures composed of vanadium carbide and oxalic acid was obtained with a precision of 0.18% after suitable corrections for γ and β absorption. Four commercial vanadium oxides and three specially prepared vanadium oxides were analyzed. The V/O ratio varied between 1.980 and 3.015. The percent standard deviation on these values was between 0.53 and 1.09%. (auth)

4800 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS FOR BROMINE IN PIG TISSUES. Friedman, M. H.; Farber, T. M.; Tanner, J. T. (Food and Drug Administration, Washington, DC). Anal. Chim. Acta; No. 67, 277-282(1973).

Bromine was determined by instrumental neutron activation analysis in tissues and organs of pigs as an indicator of brominated vegetable oil residues. The bromine content was found to be dose-related. An advantage of this technique is that the sample was not treated chemically. The analyses were done with the aid of an automatic sample changer and computer reduction of the data. Rapid and reliable analyses were obtained at the ppM level. (auth)

4801 ACCURATE DETERMINATION OF MAJOR COMPONENTS IN Ga_xSe_y BY MEANS OF INSTRUMENTAL NEUTRON ACTIVATION. Bruninx, E. (Philips Research Labs., Eindhoven, Netherlands). Anal. Chim. Acta; 67: 17-28(1973).

The various phases of the major component analysis of Ga_xSe_y by means of instrumental neutron activation were examined. The overall uncertainty for each element was of the order of 0.1% of the final concentration, and no indication of systematic error was found between neutron activation analysis and the comparative method, i.e. wavelength-dispersive x-ray fluorescence analysis. The pronounced reduction in the overall uncertainty was made possible by an improved version of a NaI(Tl) detector (scintillation chamber) and by rotation of the samples during irradiation. (auth)

4802 QUANTITATIVE DETERMINATION OF ELEMENTS IN NORMAL HUMAN ENAMEL AND DENTIN BY NEUTRON ACTIVATION ANALYSIS AND HIGH-RESOLUTION GAMMA SPECTROMETRY. Retief, D. H. (Univ. of the Witwatersrand, Johannesburg); Cleaton Jones, P. E.; Turkstra, J.; de Wet, W. J. Rev. Belge Med. Dent.; 27: No. 2, 245-256(Mar 1972). (In Afrikaans).

A technique for the quantitative analysis of different elements (Na, Mg, Cl, Ca, Cr, Mn, Fe, Co, Zn, Be, Sr, Ag, Sb, Ba, and Au) by an experimental method on samples of enamel and dentin is described. The majority of the results obtained correspond to those published using other techniques. (tr-auth)

4803 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF HIGH-PURITY ALUMINIUM AND IRON. Mamuro, T.; Mizohata, A. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 23-29(Mar 1973).

An attempt was made to apply instrumental neutron activation analysis to the determination of trace elements in high-purity aluminum and iron samples. The elements, Na, Sc, Cr, Fe, Co, Zn, As, Sb, Ba, La, Ce, Sm, Tb, Lu, Hf, and Th, were determined for Al samples, and the elements, Al, V, Cu, Co and Mn, for Fe samples. Some of the determined values were compared with those obtained by mass spectrometry elsewhere. When carrying out activation analysis of trace elements in a high-purity material by irradiation with reactor neutrons, special attention should be paid to the radioactivities produced from the matrix elements through other reactions than (n,γ). The reactions $^{27}Al(n,\alpha)\ ^{24}Na$ and $^{56}Fe(n,p)\ ^{56}Mn$ interfere with the determinations of Na impurity in Al and Mn impurity in Fe, respectively. The determinations of Na in Al and Mn in Fe were made by irradiation with neutrons of high cadmium ratio. However, the determination of a few ppM Cr in Fe was difficult because the reaction $^{54}Fe(n,\alpha)\ ^{51}Cr$ is induced not only by fast neutrons but also by thermal neutrons. (auth)

4804 SODIUM AND POTASSIUM IN FETAL AND MATERNAL RAT TISSUES. Robkin, M. A.; Schneider, J. N. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 17: 94-95(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4805 DETERMINATION OF TRACE IODINE IN URINE BY NEUTRON ACTIVATION ANALYSIS: APPLICATION OF THE SZILARD–CHALMERS EFFECT. Blotcky, A. J.; Rack, E. P.; Duven, D.; Grauer, W. M. (Veterans Administration Hospital, Omaha). Trans. Amer. Nucl. Soc.; 17: 96-97(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4806 TRACE METAL CONCENTRATIONS IN HUMAN FETAL LIVERS. Robkin, M. A.; Swanson, D. R.; Shepard, T. H. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 17: 97-98(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4807 INTERCOMPARISON OF TRACE ELEMENT DETERMINATIONS FROM FIVE ANALYTICAL TECHNIQUES. Camp, D. C. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 106(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4808 METALLURGICAL COPPER DETERMINATION WITH ^{252}Cf NEUTRONS AND CAPTURE GAMMA RAYS. Duffey, D. (Univ. of Maryland, College Park); Balagna, J. P.; Wiggins, P. F.; Elkady, A. A. Trans. Amer. Nucl. Soc.; 17: 120-121(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4809 ANALYTICAL CALIBRATION METHOD FOR IN SITU NEUTRON CAPTURE GAMMA SONDES. Sohrabpour, M. (Pahlavi Univ., Shiraz, Iran); Bull, S. R. Trans. Amer. Nucl. Soc.; 17: 121-122(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4810 FAST-NEUTRON ACTIVATION ANALYSIS WITH A ^{252}Cf SOURCE. Lutz, G. J. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 125(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4811 TRACE ELEMENTS CHARACTERIZATION OF FOSSIL FUEL STANDARDS USING NEUTRON ACTIVATION ANALYSIS. Gills, T. E.; LaFleur, P. D. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 126-127(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4812 EVALUATION OF FAST-NEUTRON SPECTRA FOR NEUTRON ACTIVATION ANALYSIS USING THRESHOLD FOILS. Becker, D. A. (National Bureau of Standards, Washington, DC); Sperberg, R. P. Trans. Amer. Nucl. Soc.; 17: 127-128(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4813 AUTOMATIC ACTIVATION ANALYSIS CODE FOR COMPONENT IDENTIFICATION AND QUANTITATIVE RESULT COMPUTATION. Yule, H. P. (NUS Corp., Rockville, MD); Lambert, J. P. F.; Goranson, S. K. Trans. Amer. Nucl. Soc.; 17: 128-129(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Chemical and Spectral Procedures

Refer also to abstracts 4992, 5152, 5155, 5244, 5468, 5576, 7421, and 7450.

4814 (BARC-678) SPECTROGRAPHIC ANALYSIS OF TWENTY ONE TRACE IMPURITIES IN HIGH PURITY NICKEL OXIDE. Karanjikar, N. P.; Saksena, M. D. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A spectrographic method for the determination of twenty one trace impurities in high-purity nickel oxide by d.c. arc technique has been developed. A mixture of graphite and indium oxide in the ratio 2:1 is used as a buffer. The buffer is mixed with the sample in the ratio 1:1. A charge of 40 mg is loaded in a 0.25-in. U. C. C. graphite electrode and is excited in a d.c. arc at 10 amps. The resulting spectra are recorded on Ilford N-30 emulsion on the 3.4-metre Ebert spectrograph with 1200 grooves/mm grating blazed at 3300 Å. The lowest determination limits for various elements lie between 1-10 ppM with an average standard deviation ±12%. (auth)

4815 (CEA-R-4515) CHRONOPOTENTIOMETRY OF Np(VI) AND Np(VII) IN ACIDIC MEDIA. Couffin, F.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Dec 1973. 80p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis. Submitted to Paris Univ., Orsay (France).

Chronopotentiometry of Np(VI) was carried out in perchloric solutions. A wave preceding the Np(VI) reduction wave is observed in the chronopotentiogramme of Np(VI) solutions oxidized by electrolysis. This wave has been attributed to the Np(VII) reduction. The presence of Np(VII) has been verified by spectrophotometry. The value of the oxidizing potentials needed to obtain Np(VII) at different pH's show that the Np(VII)/Np(VI) formal potential decreases with pH contrary to expectation. To interpret this variation it is necessary to suppose that Np(VII) in acidic media exists as an anion more oxygenated than NpO_2^+. The measured formal potential is +1.86 V and pH 1 and near the estimated value obtained from chemical reactions. (auth)

4816 (COO-3236-6, pp 44-45) MASS SPECTROMETRY AND DATA REDUCTION. Lancet, M. S.; Nachimson, S. B. 31 May 1973.

In nuclear chemistry and geochemistry research.

4817 (HEDL-TME-73-72) PERFORMANCE OF A PROCESS GAS CHROMATOGRAPH ANALYZING SODIUM COVER GAS. Barton, G. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 32p. AT.

A commercial process gas chromatograph was operated on the Small Components Evaluation Loop and the Prototype Applications Loop for approximately nine months. These tests demonstrated that the gaseous impurities, hydrogen, oxygen, nitrogen, methane and carbon monoxide, could be measured in argon at levels of 5 ppm or less. Changes in concentration of the measured impurities could be related to operating conditions of the loops. (auth)

4818 (K-L-6323) SAMPLING INFLUENCE ON URANIUM HEXAFLUORIDE ANALYSES. Wertz, R. J. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 11 Sep 1973. Contract W-7405-eng-26. 13p. (CONF-731011-1). Dep. NTIS $3.00.

From seventeenth conference on analytical chemistry in nuclear technology; Gatlinburg, Tennessee, USA (23 Oct 1973).

Pitfalls in uranium hexafluoride sampling procedures are discussed. Topics considered are: uranyl fluoride effect on the apparent purity of UF_6; metallic contamination effect on the apparent purity of pure UF_6; effect of vapor volume on UF_6 purity analysis; and effect of sample size on isotopic abundance contamination. (DHM)

4819 (NBL-269) EVALUATION OF AN INTERLABORATORY COMPARISON INVOLVING PYROCARBON AND SILICON CARBIDE COATED URANIUM-THORIUM CARBIDE BEADS. Bingham, C. D.; Whichard, J. (USAEC New Brunswick Lab., N. J.). Nov 1973. 56p. Dep. NTIS $5.45.

An interlaboratory comparison program was conducted between six chemistry laboratories and three nondestructive assay laboratories. The material of interest was pyrocarbon- and silicon carbide-coated uranium-thorium carbide beads. Accuracy of uranium and thorium measurements was ascertained by supplying to the laboratories uranium oxide and thorium oxide samples containing known quantities. With one exception, the accuracy of the chemical analysis of uranium was within a range of 0.5% relative to the prepared value. Within-laboratory precisions ranged from 0.013 to 0.39% RSD for the mixed oxide samples. Chemical assay of the beads exhibited a range of nearly ±1% (relative) about the interlaboratory chemical average for uranium content. Within-laboratory precisions ranged from 0.03 to 0.38% RSD. Some dependence on sample preparation was evidenced. NDA measurements on mixed oxides showed biases as high as 3% from the prepared values. Measurements on coated beads were nearly comparable with chemical measurements in accuracy. (auth)

4820 (NP-19859) PHOTOMETRIC DETERMINATION OF MOLYBDENUM IN STEEL. Technical Note 303. Schunke, R. H. (Defence Standards Labs., Maribyrnong (Australia)). May 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The current British Standard method (B.S. 1121: Part 48: 1966) for the determination of molybdenum in iron and steel involves extraction of the molybdenum-oxy-thiocyanate complex with an organic solvent, and specifies measurement of optical densities at a closely controlled temperature. The factors influencing the stability and temperature dependence of the complex have been examined, and it is shown that minor modifications to the superseded British Standard procedure (B.S. 1121: Part 34: 1955) give results which are independent of temperature within

the range 20 to 30°C. The modified method is both rapid and reliable, and does not involve extraction of the complex with organic solvents. (auth)

4821 EXISTENCE OF DI-IODIDES. Detection and Determination of Iodides in the Presence of Chlorides, Bromides, and Thiocyanides. Pilipenko, A. T.; Ol'khovich, P. F. (Kiev State Univ.). Ukr. Khim. Zh.; 39: No. 7, 716-718(Jul 1973). (In Russian).

A study was carried out on the conditions of formation and of extraction of the diiodide of diantipyrylmethane and on its composition as a preparative method. Methods are proposed for the qualitative and quantitative determination of iodides in the presence of chlorides, bromides and thiocyanides. The method may also be used to extract iodine from acid solutions. (auth)

4822 DETERMINATION OF BORON IN SOLUTION TO SUB-ppB CONCENTRATIONS BY HOLLOW-CATHODE EMISSION. Daughtrey, E. H.; Harrison, W. W. (Univ. of Virginia, Charlottesville). Anal. Chim. Acta; No. 67, 253-258(1973).

The determination of boron in solutions to sub-ppB concentrations by hollow-cathode emission is demonstrated. The effects of cathode material, clean-up procedure, fill gas, and tube current were investigated to determine the conditions yielding optimal sensitivity. The boron atomic line emission is 200 times as intense as boron oxide band emission. (auth)

4823 ANALYTICAL USES OF SOME N-NITROSO-N-ALKYL (OR -N-CYCLOALKYL)HYDROXYLAMINES. I. N-nitroso-N-cyclohexylhydroxylamine. Buscarons, F.; Canela, H. (Univ. of Barcelona). Anal. Chim. Acta; No. 67, 349-355(1973).

The analytical properties of N-nitroso-N-cyclohexylhydroxylamine ("hexahydrocupferron") are described. This reagent is much more stable in acidic media than its analogue cupferron, but offers very similar reactions and sensitivities. The solubility, R_F and pK values, uv and ir spectra for the reagent are given. Very sensitive qualitative tests for iron, vanadium, and titanium are reported. A turbidimetric determination of aluminium(III), suitable for 0.6–10 μg Al ml^{-1}, is evaluated. (auth)

4824 SOLVENT EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM IN IRON. Patil, S. P.; Shinde, V. M. (Shivaji Univ., Kolhapur, India). Anal. Chim. Acta; No. 67, 473-476(1973).

Studies on the solvent extraction of molybdenum(VI) with 4-methyl-2-pentanol (methyl isobutyl carbinol) showed that molybdenum(VI) can be quantitatively extracted with 50% 4-methyl-2-pentanol in benzene from 1 M hydrochloric acid containing 10 M lithium chloride. The metal ion in the organic phase can be determined spectrophotometrically as the orange-red thiocyanate complex at 465 nm. Solvent extraction of molybdenum(VI) with methyl isobutyl carbinol eliminates most of the drawbacks with other methods. The method is rapid and extremely simple and the tolerance limit for foreign ions is high. (auth)

4825 INDIRECT DETERMINATION OF SOME IONS BY FLAMELESS ATOMIC ABSORPTION USING A WIRE LOOP ATOMIZER. Newton, M. P.; Davis, D. G. (Louisiana State Univ., New Orleans). Anal. Lett.; 6: No. 10, 923-932(Oct 1973).

In previous studies using a wire loop atomizer with a preconcentrating soaking step it has been reported that there are sometimes interferences due to other species in the sample besides the metal of interest. It is possible to use this interference to advantage as an indirect method for some anions and metals that are determined only with poor sensitivity by atomic absorption spectroscopy. Cyanide, lanthanum, and zirconium were studied to determine if useful calibration curves and low detection limits could be obtained by this indirect method. (auth)

4826 MEASUREMENT OF NITROGEN AND NITROGEN ISOTOPIC RATIOS USING REDUCTION PYROLYSIS COUPLED WITH MASS SPECTROMETRY. Carter, J. A.; Matthews, D. R.; Walker, R. L.; Walton, J. R. (Oak Ridge National Lab., TN). Anal. Lett.; 6: No. 10, 951-960(Oct 1973).

An analytical system for measuring total nitrogen and its isotopic abundance in a variety of environmental samples has been developed. A reductive pyrolysis system and a directional focusing 6-inch gas mass spectrometer were combined into the analytical system. In the reductive part of the system, nitrogen species are converted to ammonia with an atmosphere of hydrogen in the presence of a heated nickel catalyst. Five percent of the gas stream is split away for measuring total nitrogen by a conductivity detector. The ammonia is removed from the gas stream employing a cold finger reaction vessel. The hydrogen-free ammonia is decomposed thermally to nitrogen and hydrogen at 1000°C, employing a hot rhenium filament. The N_2 produced from the decomposition is used for measuring the abundance of masses 28 and 29 by mass spectrometry. From this ratio, the ^{15}N atom fraction is calculated. Standard samples of N_2, ammonia, orchard leaves, and urea have been successfully analyzed to determine isotopic compositions. Samples containing as little as 20 μg of total nitrogen can be analyzed by this system. By the addition of multi-reaction vessels, three samples may be completed per hour. (auth)

4827 SPECTROGRAPHIC MICRODETERMINATION OF TUNGSTEN AND MOLYBDENUM ON THE BASIS OF SiO_2. Shuvalova, E. I.; Khlystova, A. D.; Tarasevich, N. I.; Gongalyuk, N. G. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 4, 490-491 (1973). (In Russian).

A method for the spectrographic microdetermination of tungsten (up to 5×10^{-4}%) and molybdenum (up to 5×10^{-4}%) on the basis of SiO_2 and CuCl (1 : 1) was worked out. The relative standard deviation is 0.10 in determining 1×10^{-3}% W and 1×10^{-3}% Mo. The factor experiment methods were utilized. (auth)

4828 NEW METALLO-CHROMOGEN INDICATOR FOR DETERMINATION OF RARE EARTH IONS. Lasovsky, J.; Rybka, M.; Ruzicka, E. (Palacky Univ., Olomouc, Czech.). Collect. Czech. Chem. Commun.; 38: No. 8, 2238-2241(Aug 1973). (In German).

Investigated was the feasibility of using floreine as metallochromogen indicator for the chelatometric determination of rare earth ions. Tested on 14 different ions and treated statistically, the results of the proposed procedure were advantageous. The confidence range of the data never exceeded 0.72 percent. (tr-auth)

4829 MOLYBDENUM(VI) AND TUNGSTEN(VI) CHELATES WITH DIPHENOLS. Bartusek, M. (Purknye Univ., Brno). Collect. Czech. Chem. Commun.; 38: No. 8, 2255-2267(Aug 1973). (In German).

The reactions of molybdenum (VI) and tungsten (VI) with pyrocatechin, pyrogallol, and other o-diphenols in aqueous solutions at pH values from 1 to 7 were studied by photometric and potentiometric pH measurements. The equilibria and the equilibrium constants were determined for the participating complex ions $MO_2L_2^{2-}$, $HMO_2L_2^-$, and HMO_3L^-. The analytical application of these chelates was also discussed. (tr-auth)

4830 DISINTEGRATION METHOD FOR MASS-SPECTROMETRIC ISOTOPIC ANALYSIS OF NITROGEN OF GASES OCCLUDED IN ROCKS. Zschiesche, M.; Maass, I. (Zentralinstitut fuer Isotopen und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 8, 298-299(Aug 1973). (In German).

For the purpose of geological dating, an apparatus milled rocks under vacuum and released the occluded gases which were prepared for isotope analysis of ^{15}N by mass spectrometry. As shown by a cross section, the milling container consisted of stainless steel walls and balls. The rock samples weighed from 150 to 250 g. After being milled from 20 to 30 hr, the samples were reduced to particle sizes of less than 0.05 mm. These samples yielded gas volumes of 0.3 to 0.5 ml nitrogen which were sufficiently large to permit reliable ^{15}N determinations. Air nitrogen served as standard. (HBG)

4831 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN AMMONIUM HYDROGEN FLUORIDE. Roca Adell, M.; Capdevila Perez, C.; Alduan, A. (Junta Energy Nuclear, Madrid). An. Quim.; 69: No. 3, 351-356(1973). (In Spanish).

Traces of Al, B, Cr, Cu, Fe, Mn, Mo, Ni, Pb, and Si have been determined spectrographically by using 10-amp. d.c. arc excitation, graphite electrodes, craters 4 mm × 4.5 or 8 mm deep and matrices of graphite, Ga_2O_3, GeO_2, MgO, ZnO or ZnO-graphite (1 : 1), in the ratios of sample to matrix of 1 : 1 and 1 : 3. Of these, ZnO in the ratio of 1 : 1, with craters 4 mm × 8 mm, was satisfactory for all impurities except Pb. (Anal. Abstr.)

4832 AMPEROMETRIC DETERMINATION OF RARE EARTHS IN ARTIFICIAL BINARY MIXTURES. Zhdanov, A. K.; Markhabaev, I. A. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 9, 1331-1333(1973). (In Russian).

Conditions under which the individual elements can be determined in La-Cl, La-Tm, and La-Cr mixtures were determined. (tr-auth)

4833 DETERMINATION OF MICROAMOUNTS OF POLYTHIONATES IN URANIUM PROCESSING LIQUOURS. Upor, E.; Nagy, G. (Mecseki Ercbanyaszati Vallalat, Kovagoszollos, Hungary). Magy. Kem. Lapja; 28: No. 7, 340-343(1973). (In Hungarian).

The determination of microamounts of sulfur as polythionates in uranium mill's liquors is described. The procedure is based on the well-known "cyanolysis". Polythionates are separated from Fe^{3+} and other interfering ions utilizing the precipitation of hydroxides at pH 10. The interfering effect of SO^{4+} was eliminated

by separating it in the form of $BaSO_4$, or by correcting it. The determination was performed by the measurement of the light absorption of the complex formed by extraction (Fe^{3+}–NCS–TOPO), after having converted the polythionates into rhodanide. Sensitivity of the procedure is better than 0.1 mg/l sulfur. Extraction with the aid of TOPO seems consequently useful for the determination of microamounts of NCS^-. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 5192, 5194, 5221, 5246, and 5726.

4834 (AREAEE-171) DISTRIBUTION OF Zr AND Y IN BLACK SAND MINERALS FROM THE MEDITERRANEAN COAST, ROSETTA, EGYPT. El-Shazly, E. M.; El-Sokkary, A. A.; Dabbour, G. A. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The present study deals with the distribution of the two elements Zr and Y among black sand minerals from the Mediterranean coast of Egypt. An x-ray fluorescence method was used to determine Zr and Y. For Zr, it is shown that the zircon fraction is a fundamental contributor beside the: quartz + feldspar, green silicate and ilmenite fractions. With respect to Y, monazite is the principal contributor followed by green silicate and quartz + feldspar fractions. It is observed that although some fractions show relatively high concentration of Y or Zr, yet their contribution to original unseparated black sand sample is insignificant because of their small modal per cent e.g. garnet and magnetite. This study can be rendered useful in quick quantitative determination of zircon or monazite in large numbers of black sand samples. (auth)

4835 (BARC-686) ANALYSIS OF COMPLEX NaI(Tl) GAMMA SPECTRA FROM MIXTURES OF NUCLIDES. Rangarajan, C.; Mishra, U. C.; Gopalakrishnan, S. S.; Sadasivan, S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 69p. Dep. NTIS (U. S. Sales Only) $5.50.

Methods of gamma spectrum analysis being used in this laboratory are described. The gamma spectra are taken with NaI(Tl) detectors of different dimensions on various multichannel analysers. The samples being analyzed are airborne fallout radioactivity, surface depositions, milk and other foodstuffs, and countrywide surface soils. These samples contain both natural gamma activities from terrestrial sources and fallout radioactivity, mostly fission products, due to nuclear explosions. The methods of analyses described are spectrum stripping, simultaneous equations and the least squares method. The relative merits and demerits of the different methods and the parameters of the instrument systems being used are also given. (auth)

4836 (COO-3236-6) NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH. Progress Report, 1972–1973. Kohman, T. P.; Karol, P. J. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). 31 May 1973. Contract AT(11-1)-3236. 60p. Dep. NTIS $5.00.

A separate abstract was prepared for each section of the report. (DHM)

For abstracts of individual papers see: 4816, 4837, 4857, 4858, 5133, 5151, 5951, and 6547.

4837 (COO-3236-6, pp 5-18) ALPHA SPECTROMETRY OF URANIUM IN TEKTITES. Nachimson, S. B.; Kohman, T. P. 31 May 1973.

In nuclear chemistry and geochemistry research.

Research progress is reported on a program to measure precisely the $^{234}U/^{238}U$ alpha activity ratio in tektites of different occurrences and ages. (DHM)

4838 (T-743, pp 3.115-3.124) APPLIED ISOTOPE TECHNIQUES AT THE FINNISH TRIGA LABORATORY. Tamminen, A. (State Inst. for Technical Research, Helsinki). 1972.

From second European conference of TRIGA reactor users, Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Two separate radioactive tracer methods and a delayed neutron analyzer system are described. A process study in a ferrochrome smelter was based on the activation of large amounts of process input materials in special sample holders on the reflector of Triga Mark II reactor. In a typical surface water study ^{82}Br-solution was injected in a waste water canal at a pulp and paper factory. The dilution mixing and flow of the tracer can be followed in the adjoining lake system for 6 to 8 days and up to a distance of 10 km. The tracer concentration was measured directly without any sampling procedures. A delayed neutron analyzer for routine uranium ore analyses is presented. A polyethylene moderator block and seven parallelly connected BF_3-detectors have been used in conjunction with a fast pneumatic sample transfer and irradiation system. (auth)

4839 DETERMINATION OF INDIUM IN ROCKS BY SUBSTOICHIOMETRIC RADIOISOTOPE DILUTION ANALYSIS. Greenland, L. P.; Campbell, E. Y. (Geological Survey, Washington, DC). Anal. Chim. Acta; 67: 29-36(1973).

Rocks containing 10–140 ng of indium per g are decomposed with hydrofluoric and nitric acids in the presence of ^{114}In. Indium is separated from other constituents by sequential extractions of the bromide, cupferronate, and acetylacetonate, and is then reached with a substoichiometric amount of EDTA. Excess of indium is removed by acetylacetone extraction and the specific activity of the complexed fraction is determined by counting ^{114}In. Analyses of the U.S.G.S. standard rocks are reported. These show good agreement with previous neutron activation analyses. Repetitive rock analyses indicated an analytical precision of ±4–7%. (auth)

4840 DETERMINATION OF TRACE ELEMENTS IN UNFUSED ROCK AND MINERAL SAMPLES BY X-RAY FLUORESCENCE. Murad, E. (Univ., Tuebingen, Ger.). Anal. Chim. Acta; 67: 37-53 (1973).

The wavelength range in which trace elements are commonly determined by x-ray fluorescence has been divided into three major regions: wavelengths longer than 1.9 Å, between 1.9 and 0.6 Å, and shorter than 0.6 Å. The factors controlling matrix effects differ somewhat in each of these regions; the methods that can be applied to compensate for these effects also differ. The least laborious correction method is the internal standard technique involving scattered x-ray tube spectra. The results are discussed in the light of trace element determinations carried out on geochemical standards. (auth)

4841 SOLVENT-EXTRACTION METHOD FOR THE DETERMINATION OF MANGANESE-54 IN SEA WATER. Flynn, W. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chim. Acta; 67: 129-134(1973).

A solvent-extraction procedure for the determination of manganese-54 in seawater is described. The water (1 l) is buffered to pH 3.8, and extracted with di(2-ethylhexyl)phosphoric acid in n-heptane. The manganese-54 with carrier is stripped from the organic phase, and eventually precipitated as the dioxide; the precipitate is dissolved in hydrochloric acid and counted in a scintillation counter. Chemical recovery is determined colorimetrically. Samples spiked with manganese-54 showed quantitative recovery from 1 l of seawater with a typical recovery of 70–75% of carrier. The method is applicable to seawater containing many other ions, and decontamination factors for a wide range of radionuclides are reported. The limit of detection is ca. 10^{-3} $\mu Ci\ ml^{-1}$. (auth)

4842 METHOD FOR DETERMINATION OF ^{59}Fe IN MARINE ORGANISMS BY RADIOCHEMICAL ANALYSIS. Urakubo, G.; Kido, Y. (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikenjo Hokoku; No. 90, 4-11(Nov 1972). (In Japanese).

A rapid and accurate method for determining ^{59}Fe in radiocontaminated marine organisms was investigated. A satisfactory method established is as follows: ^{59}Fe is fractionated by ion exchange followed by precipitation as hydroxide or oxalate, or extraction with methyl isobutyl ketone (MIBK) from the sample solution. Subsequently, in both cases mentioned above, ^{59}Fe is precipitated as tris-(benzoylphenylhydroxylaminato)iron(III). After the chelate compound is decomposed with the mixture of perchloric acid-nitric acid, ferric ion is precipitated as hydroxide and electrodeposited on a copper plate. Radioactivity of ^{59}Fe on the copper plate is measured by a low-background counter and the recovery of iron-carrier is determined gravimetrically. In the present method, about 3pCi of ^{59}Fe could be determined with recovery above 95% in about 8 hrs. Iron-59 incorporated into fish and clam organs was analyzed by the present method to indicate that highly contaminated organs were liver, fin, and gill of fishes and midgut gland of clams. Accordingly, analysis of the organs of marine organisms mentioned above is suited for elucidating the contamination index of ^{59}Fe. (auth)

4843 SPECTROCHEMICAL ANALYSIS UTILIZING ENERGY DISPERSIVE X-RAY FLUORESCENCE INDUCED BY A RADIOISOTOPE SOURCE. Kulkarni, P. V. Troy, NY; Rensselaer Polytechnic Inst. (1973). 182p. University Microfilms Order No. 73-27,218.

Thesis (Ph. D.).

Analytical methods based on x-ray emission using a 7-8 mCi ^{109}Cd x-ray source for excitation and energy dispersion with a semiconductor detector are studied. Design and applications of x-ray emission analyzers using radioisotope x-rays are discussed. Analytical sensitivity for elements in low atomic number matrices in the nondispersive radioisotopic x-ray fluorescence was evaluated and the sensitivities for quantitative analysis for nanomole concentrations of biologically important middle Z

elements, such as Cu and Zn, were achieved. These elements were deposited in a polyacrylamide gel so that the matrix closely resembled a biological medium. (LK)

4844 DETERMINATION OF TIN CONTENT BY RESONANCE GAMMA ABSORPTION. Zahradnik, L. (Geoindustria, Prague). Geol. Pruzkum; 14: No. 6, 180-181(Jun 1972). (In Czech).

The Moessbauer effect was applied in determining tin content in the Kentei deposit in the Mongolian Peoples' Republic. In the measurements, the Soviet-made MAK-1 device was employed. Its operation is based on the ability of ^{119}Sn isotope nuclei to absorb, by resonance, radiation having an energy of 23.8 keV emitted by the ^{119m}Sn radioisotope. (Nucl. Sci. Abstr. Czech.)

4845 METHOD OF DETERMINING PLUTONIUM-239 IN URINE. Mikhailova, O. A.; Shvydko, N. S.; Popov, D. K. Gig. Sanit.; No. 8, 69-71(Aug 1973). (In Russian).

Since published methods for ^{239}Pu determination generally recommend reagents and resins not available commercially in the USSR, locally available materials were investigated. A method was developed in which Pu(IV) as the cupferronate is separated from macro impurities by chloroform extraction from a nitric acid medium using zirconium carrier or no carrier. ^{241}Am, U, Th, and 3% of the ^{239}Pu remain in the aqueous phase. The ^{210}Po is removed from the plutonium by precipitation on a nickel disk or with mercury. After removal of the chloroform from the organic phase, the ^{239}Pu is precipitated with ammonia, using a lanthanum carrier, and is counted after further processing. The Pu can also be electroprecipitated. (TTT)

4846 MEASUREMENT OF EXTREMELY LOW-LEVEL RADIOIODINE IN AIR. Goldstein, N. P.; Sun, K. H.; Gonzalez, J. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 68-69(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4847 ANALYSIS OF LEAD AND SULFUR DIOXIDE IN AMBIENT AIR BY X-RAY FLUORESCENCE. Oren, M. R.; Watson, T. III; Parkinson, T. F. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 17: 69(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4848 ELEMENTAL ANALYSIS OF AEROSOL-SIZE FRACTIONS BY PROTON-INDUCED X-RAY EMISSION. Johansson, T. B.; Nelson, J. W.; Van Grieken, R. E.; Winchester, J. W. (Florida State Univ., Tallahassee). Trans. Amer. Nucl. Soc.; 17: 103(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4849 TRACE ELEMENT ANALYSIS OF ENVIRONMENTAL SAMPLES USING RADIOISOTOPIC-EXCITED X-RAY FLUORESCENCE. Cooper, J. A. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 103-104(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4850 TRACE ELEMENT ANALYSIS USING X-RAY TUBES AND SEMICONDUCTOR DETECTOR SPECTROMETERS. Giauque, R. D. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 17: 104-105(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4851 APPLICATIONS OF ENERGY-DISPERSIVE X-RAY FLUORESCENCE. Camp, D. C. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 107(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4852 APPLICATION OF X-RAY FLUORESCENCE ANALYSIS TO PROBLEMS IN FORENSIC SCIENCE. Pate, B. D. (Simon Fraser Univ., Burnaby, BC). Trans. Amer. Nucl. Soc.; 17: 107-108(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4853 MEDICAL APPLICATIONS OF FLUORESCENT EXCITATION ANALYSIS. Kaufman, L. (Univ. of California, San Francisco). Trans. Amer. Nucl. Soc.; 17: 108(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4854 MICROANALYSIS IN THE ELECTRON MICROSCOPE. Russ, J. C. (Edax Lab., Raleigh, NC). Trans. Amer. Nucl. Soc.; 17: 109(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4855 MEASUREMENT OF RADON PROGENY CONCENTRATIONS IN AIR. Kerr, G. D. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 542-543(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Separation Procedures

4856 (CEA-R-4514) CAPRIC ACID EFFECT ON ACTINIDES EXTRACTION BY TRILAURYLAMMONIUM NITRATE. Madic, C.; Koehly, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Dec 1973. 33p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

Capric acid effect on trilaurylammonium nitrate extraction of actinides at the III, IV, VI oxidation states has been studied. The various parameters explored are: capric acid concentration, trilaurylammonium nitrate concentration, aqueous acidity and metallic specie concentration. According to aqueous acidity, two influences are observed: inhibitor effect and exaltation effect. These influences are explainable by two reactions: formation of an addition compound: $R_3NHNO_3(HA)_2$, nitric acid deplacement of trilaurylammonium nitrate with $R_3N(HA)_4$ formation. The equilibrium constants of the reactions: $R_3NHNO_{3org.} + (HA)_{2org.} \rightleftharpoons R_3NHNO_3(HA)_{2org.}$ and $R_3NHNO_{3org.} + 2(HA)_{2org.} \rightleftharpoons R_3N(HA)_{4org.} + H^+ + NO_3^-$ are respectively: 0.0287 and 20.8. (auth)

4857 (COO-3236-6, pp 46-51) CHEMICAL PROCEDURES FOR LOW-LEVEL ISOTOPIC ANALYSIS OF LEAD, THALLIUM, URANIUM, THORIUM, AND LITHIUM. Lancet, M. S. 31 May 1973.

In nuclear chemistry and geochemistry research.

A description is given of a method for extracting all elements of interest from the same meteorite sample. The method involves ion exchange separations of Tl, Pb, U, Th, and Li. (DHM)

4858 (COO-3236-6, pp 52-55) SEPARATION OF RARE-EARTH ELEMENTS FOR GEOCHRONOLOGICAL APPLICATIONS. Lin, C. C. 31 May 1973.

In nuclear chemistry and geochemistry research.

A cation exchange column chromatographic method for separating rare earths is described. The eluant used is α-hydroxy-α-methylbutyric acid and ^{145}Sm and ^{147}Pm are used as tracers. (DHM)

4859 ION EXCHANGE BEHAVIOR OF SOME INORGANIC IONS IN SYSTEMS OF POROUS ION EXCHANGE RESINS. Akatsu, E. (Japan Atomic Energy Research Inst., Tokai); Aratono, Y.; Bahk, C. Y. J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 453-457 (Aug 1973).

The distribution ratios of certain inorganic ions (Fe, Co, Zn, Sr, Y, Zr, Nb, Mo, Tc, Ru, Pd, Te, I, Cs, Ba, La, Ce, Eu, Tm, U, and Th) were radiochemically determined in systems of ion exchange resin of porous type vs 0.1 to 1.0M hydrochloric acid or water. The resins used were the cation exchange resins Diaion PK-216 and Amberlite IR-200 (H form), and the anion exchange resins Diaion PA-316 and Amberlite IRA-900 (Cl form). The results concurred with those obtained with ion exchange resins of gel-type (Diaion SKN-1 and SAN-1). The ion exchange behavior of ^{137}Cs was examined by means of an ion exchange resin column. The resin bed consisted of a 2:1 mixture of Diaion PK-216 and PA-316. The decontamination factors were determined at a flow rate of 120 and 180 (hr^{-1}) in space velocity. The values were higher than those obtained with a mixture of ion exchange resin of gel-type (Diaion SKN-1 and SAN-1). (auth)

4860 PROCESS FOR THE SEPARATION OF COMPONENTS FROM GAS MIXTURES. Merriman, J. R.; Pashley, J. H.; Stephenson, M. J.; Dunthorn, D. I. (to United States Atomic Energy Commission). US Patent 3,762,133. 2 Oct 1973. Filed date 15 Oct 1971. 22p.

A process for the removal, from gaseous mixtures of a de-

sired component selected from oxygen, iodine, methyl iodide, and lower oxides of carbon, nitrogen, and sulfur is described. The gaseous mixture is contacted with a liquid fluorocarbon in an absorption zone maintained at superatmospheric pressure to preferentially absorb the desired component in the fluorocarbon. Unabsorbed constituents of the gaseous mixture are withdrawn from the absorption zone. Liquid fluorocarbon enriched in the desired component is withdrawn separately from the zone, following which the desired component is recovered from the fluorocarbon absorbent. (Official Gazette)

4861 RETENTION OF TRACE ELEMENTS IN WATER DURING LYOPHILIZATION. Harrison, S. H. (National Bureau of Standards, Gaithersburgh, MD); LaFleur, P. D.; Zoller, W. Trans. Amer. Nucl. Soc.; 17: 68(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4862 RECENT RESULTS OF THE APPLICATION OF COLUMNAR EXTRACTION CHROMATOGRAPHY IN INORGANIC ANALYSIS. Stronskii, I. (Inst. of Nuclear Physics, Krakow). Isotopenpraxis; 9: No. 8, 273-279(Aug 1973). (In German).

Summarized are recent advances in reversed phase column extraction chromatography of inorganic substances. The discussion centers on the practical application of the procedure to separate lanthanides and transplutonium elements as well as to separate lanthanides from transplutonium elements. Also discussed are separation and purification of actinides, separation of uranium from its fission products, and separation of other metals as well as nonmetals. (HBG)

4863 DEPENDENCE OF MOLYBDENUM SORPTION DEGREE ON THE POROSITY OF THE SORBENT. Kholmogorov, A. G.; Nadol'skii, A. P.; Pilipchuk, Yu. S.; Il'ichev, S. N. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 69-72(1973). (In Russian).

The porosity of the anionite AV-17 was studied by electron and optical microscopic methods in relation to the concentration of divinyl benzene and the quantity of modifier. It was established that a macroporous structure is created in AV-17 with divinyl benzene content of 8 to 12% with modifying isooctane in quantity of 0.8 to 1.0 part by weight. The dependence of the degree of sorption of Mo on the porosity of the anionite AV-17P was determined. It was shown that the PDOE size of the sorbent with respect to Mo after sorption from solutions with pH = 8.5, 5.0, and 2.5 can be used for the determination of the optimum porosity of the anionite AV-17P. (tr-auth)

4864 THIN-LAYER CHROMATOGRAPHIC DATA FOR INORGANIC SUBSTANCES. Brinkman, U. A. T. (Free Reformed Univ., Amsterdam); De Vries, G.; Kuroda, R. J. Chromatogr.; 85: No. 2, 187-526(24 Oct 1973).

Studies on thin-layer chromatography published through 1972 are reviewed. The review is divided into chapters according to the cations and/or anions chromatographed. (LK)

4865 SYNERGISM IN EXTRACTING SEVERAL CHELATE COMPLEXES OF 1-PHENYL-3-METHYL-4-BENZOYL-5-PYRAZOLONE. Navratil, O.; Mikulec, Z. (Purkyne Univ., Brno). Collect. Czech. Chem. Commun.; 38: No. 8, 2430-2440(Aug 1973). (In German).

The distribution of complexes of cobalt, cerium, and europium with 1-phenyl-3-methyl-4-benzoyl-5-pyrazolone (HA) was studied between benzene or toluene and the aqueous phase of 0.1 ionic strength. In the organic phase, the complexes CoA_2, EuA_3, and CeA_3 were extracted; for $c_{HA} \geq 0.02$ mole, the complexes $CoA_2 \cdot HA$ and $EuA_3 \cdot HA$ also were extracted. The corresponding extraction constants were determined. Additions of either tri-n-butyl phosphinoxide or tri-n-octyl phosphinoxide acted strongly synergistic on the extraction. Other additions also were studied and the corresponding constants were determined. (HBG)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 4789, 4954, 5382, and 7452.

Chemical and Physicochemical Properties

Refer also to abstracts 5064, 5154, 5441, 7424, 7437, and 7443.

4866 ANIONIC ELECTROPHORETIC PATTERN OF FIVE RUTHENIUM SALTS IN FRESH AND SEA WATER: EFFECTS OF AGEING AND DILUTION. Vos, J. (CEN, Mol, Belg.); Van Puymbroeck, S.; Van der Borght, O.; Peperstraete, H.; D'Hont, M. Anal. Chim. Acta; No. 67, 480-485(1973).

The presence of ruthenium species in the wastes of nuclear fuel reprocessing plants has led to considerable interest in the very complex behavior of ruthenium. This study aimed to relate the physico-chemical characteristics of different ruthenium salts to their differences in fixation by aquatic organisms, differences observed under laboratory conditions. Five ruthenium salts were studied for influence of dilution and aging, by means of high-voltage electrophoresis: (a) in concentrated aqueous solutions; (b) after further dilution with fresh water; and (c) after further dilution with sea water. (auth)

4867 INTERACTION OF INDIUM WITH CHLORIDE MELTS CONTAINING NIOBIUM AND ZIRCONIUM. Aleksandrov, E. P.; Vasin, B. D.; Zhezher, N. G.; Nichkov, I. F.; Raspopin, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 79-81(1973). (In Russian).

The interaction of melts of NaCl–KCl containing Nb or Zr ions, with liquid In was studied. Results showed that the In almost completely reduces the Nb ions to the metallic state. The degree of reduction does not depend on the original concentration of the Nb in the electrolyte. The In does not reduce the Zr^{4+} ions to the metallic state. This is explained by the fact that under the test conditions alloys of In and Zr are not formed. (JSR)

Isotope Effects

Refer also to abstracts 5096 and 5493.

4868 DEUTERIUM, METHYL, AND SOLVENT EFFECTS ON THE PHOSPHORESCENCE LIFETIME OF BENZENE. Haaland, D.M. (Department of Chemistry, University of Rochester, Rochester, New York 14627); Nieman, G.C. J. Chem. Phys. 59: No. 3, 1013-1027 (1 Aug 1973).

The phosphorescence lifetimes of benzene and a number of its methyl and deutero derivatives have been investigated in a wide variety of solvents at temperatures below 65 °K. Deuterium effects indicate a dominant role for the aryl hydrogens in the radiationless process. Methylation increases the triplet decay rate by approximately 25% per methyl group in a nearly linear fashion. Intensity data indicate that this is not due to "allowed" character introduced by any reduction in molecular symmetry as is theoretically predicted to be the case. Perfluorocarbons act as inert solvents for benzene derivatives whereas typical hydrocarbons produce 50% or greater changes in the lifetimes even at very low temperatures. The data suggest a common mechanistic pathway (or perturbed state) for both the effects of solvent and methyl groups. (auth)

4869 RECOMBINATION OF IODINE ATOMS BY FLASH PHOTOLYSIS OVER A WIDE TEMPERATURE RANGE. IV. KINETIC ISOTOPE EFFECT. Chang, H.W.; Burns, G. (Lash Miller Chemical Laboratories, University of Toronto, Toronto M5S 1A1, Ontario, Canada). J. Chem. Phys. 59: No. 3, 1043-1044 (1 Aug 1973).

Recombination of I atoms was studied, by flash photolysis, in the presence of an excess of H_2, HD, and D_2, between 300 and about 580 °K. The recombination rate constants were summarized by the following equations: $\log k_r^{H_2} = 9.686 - 2.054 \log(T/300)$, $\log k_r^{HD} = 9.617 - 1.737 \log(T/300)$, $\log k_r^{D_2} = 9.547 - 1.772 \log(T/300)$. The variation in rate constants with isotopic substitution of the third body suggests that the recombination proceeds via the energy transfer mechanism. It is also consistent with earlier trajectory studies on the third body mass effect in recombination reactions. (auth)

4870 ISOTOPE EFFECT DURING DIFFUSION OF MAGNESIUM IN SILVER. Heumann, T. (Univ., Muenster, Ger.); Kohl, J. G. Acta Met.; 22: No. 1, 21-26(Jan 1974). (In German).

The diffusion of magnesium in silver takes place in the solid solution of the system Ag–Mg. The concentration dependence of their diffusion coefficients has been calculated for the concentration range 6 at. % $\geq c_{Mg} \geq$ 0 at. % using the method of Matano and Hall. At 812.5°C the ratio of magnesium and silver diffusion coefficients in an infinitely diluted solution is 4.00. The isotope effect has been determined by means of mass spectroscopy. The isotope effect estimation from the diffusion in a chemical concentration gradient is based upon the Hall evaluation of the c–x-curves. From the changes of the relative abundance ratio of the magnesium isotopes ^{25}Mg and ^{26}Mg during diffusion in silver an isotope effect E = 0.08 is evaluated for the temperatures 812.5°C. (auth)

4871 TRITIUM ISOTOPE EFFECT OF SN-GLYCEROL 3-PHOSPHATE OXIDASE AND THE EFFECTS OF CLOFENAPATE AND N-(2 BENZOYLOXYETHYL) NORFENFLURAMINE ON THE ESTERIFICATION OF GLYCEROL PHOSPHATE AND DIHYDROXYACETONE PHOSPHATE BY RAT LIVER MITOCHONDRIA.

Bowley, M.; Manning, R.; Brindley, D. N. (Univ. of Nottingham, Eng.). Biochem. J.; 136: No. 2, 421-427(Oct 1973).

Owing to a ^3H isotope effect, the mitochondrial sn-glycerol 3-phosphate oxidase (EC 1.1.99.5) had a mean activity which was 8.4 times less with sn-[2-^3H]- than with sn-[1-^{14}C] glycerol 3-phosphate as a substrate. A method for measuring the simultaneous synthesis of lipid from glycerol phosphate and dihydroxyacetone phosphate in rat liver mitochondria is described. The lipid synthesized by rat liver mitochondria from sn[1-^{14}C] glycerol 3-phosphate was mainly phosphatidate and lysophosphatidate, whereas that synthesized from dihydroxy [1-^{14}C] acetone phosphate was mainly acyldihydroxyacetone phosphate. Additions of NADPH facilitated the conversion of acyldihydroxyacetone phosphate into lysophosphatidate and phosphatidate. Hydrazine (1.4 mM) or KCN (1.4 mM) inhibited the synthesis of lipids from dihydroxyacetone phosphate but not from glycerol phosphate. Clofenapate (1-2.5 mM) inhibited the synthesis of lipids from dihydroxyacetone phosphate but slightly stimulated synthesis from glycerol phosphate. The methanesulphonate of N-(2-benzoyloxyethyl) norfenfluramine, at 0.25 to 0.75 mM, inhibited lipid synthesis from both glycerol phosphate and dihydroxyacetone phosphate. (auth)

4872 DEUTERIUM AND TRITIUM. Mackay, K. M. (Univ. of Waikato, Hamilton, N. Z.); Dove, M. F. A. pp 77-116 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on deuterium and tritium that also considers their compounds. (181 references) (DHM)

4873 HYDROLYSIS OF Y^{3+}, La^{3+}, Gd^{3+}, Er^{3+} IONS IN HEAVY WATER. Amaya, T.; Kakihana, H.; Maeda, M. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 46: No. 9, 2889-2890(Sep 1973).

Hydrolysis of Y^{3+}, La^{3+}, Gd^{3+}, and Er^{3+} ions in heavy water (D_2O) was studied. Compositions of the species formed in heavy water are the same as those in light water, while the values of the equilibrium constants are smaller in heavy water than in light water. (LK)

Isotope Exchange and Isotope Separation

4874 ISOTOPIC EXCHANGE OF DEUTERIUM WITH HYDROGEN OF SOME HYDRIDES. Novakova, J.; Jiru, P.; Zavadil, V. (Inst. of Physical Chemistry and Electrochemistry, Prague). Collect. Czech. Chem. Commun.; 38: No. 8, 2320-2326(Aug 1973).

Exchange of deuterium was studied with commercial potassium and barium hydrides, hydrides of pure niobium and tantalum metals, yttrium hydride, and with hydrides of rare earths metals. Non-stoichiometric composition of the hydrides made impossible a quantitative evaluation of the exchange mechanism. In most cases the ability to exchange deuterium with hydride hydrogen was found to be connected with the thermal stability of the hydrides. (auth)

4875 SITE-SPECIFIC METHOD FOR DEUTERATION: REDUCTION OF ARYL HALIDES WITH SODIUM BORODEUTERIDE AND PALLADIUM CHLORIDE. Bosin, T. R.; Raymond, M. G.; Buckpitt, A. R. (Indiana Univ., Bloomington). Tetrahedron Lett.; No. 47, 4699-4700(Nov 1973).

Sodium borohydride-transition metal systems produced reductions not achieved by sodium borohydride alone, such as dehalogenation of aryl halides. The reaction was used to introduce a deuterium atom into an aromatic system. Details are presented of the preparation of 4-deuterobenzoic acid, and a list is given of ten other aryl halides which have been specifically deuterated. (UK)

4876 SEPARATION OF BORON ISOTOPES BY MEANS OF WEAK-BASE ANION EXCHANGE RESIN. Kotaka, M.; Murayama, K.; Kakihana, H. (Tokyo Inst. of Tech.). Nippon Kagaku Kaishi; 1973: No. 8, 1482-1485(Aug 1973). (In Japanese).

Aqueous solution containing 5 mmol of boric acid was passed through a column packed with weak-base anion exchange resin, Diaion WA 21 in free base form (0.8 cm^2 × 48 cm bed), and the borate band formed on the column was eluted with pure water. The boric acid concentration in each fraction of the effluent was determined by acid-base titration with manitol. The atomic fraction of the boron-10 in each fraction was determined by means of Varian Mat CH 5 mass spectrometer, using the surface ionization method. In these experiments it was found that: (1) Boron-10 was considerably enriched in the rear part of the band, and depleted in the frontal part. (2) The boric acid charged on the column was completely eluted with pure water. (3) The elution curve was influenced effectively by operation temperature; the higher the temperature became (from 5°C to 40°C) the sharper the elution peak became. (4) Boric acid concentration and flow rate gave a little influence on the elution curve; increase of boric acid concentration up to 1.0 mol/l and decrease of flow rate tended to give sharper elution peak. (auth)

4877 COMPARATIVE STUDY OF CATALYTIC DEUTERIUM EXCHANGE IN CYCLOBUTANE, CYCLOPENTANE, AND CYCLOHEXANE. Guczi, L.; Sarkany, A.; Tetenyi, P. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 77: No. 4, 417-425(1973).

The catalytic hydrogen–deuterium exchange in cyclobutane, cyclopentane and cyclohexane on unsupported nickel power catalyst has been investigated. The rate of exchange under the exactly same circumstances decreases in order of cyclopentane > cyclohexane > cyclobutane and the energy of activation increases 50 < 67 < 75 $kJ \cdot mol^{-1}$, respectively. On a catalyst of high activity the exchange is characterized by the formation of perdeuterated compounds for cyclopentane and cyclohexane. By diminishing the catalytic activity the proportion of d_1 isomer in cyclohexane and d_2 isomer in cyclopentane is increased. The change of distribution is explained by the rise in the number of surface nickel atoms of low coordination. The exchange of cyclobutane on nickel of low catalytic activity shows maxima at cyclobutane-d_1 and d_8 but this spectrum was strongly disturbed by the deuterogenolysis of cyclobutane. (auth)

4878 PART I. THE POLARIZED SINGLE CRYSTAL ELECTRONIC SPECTRA OF TRANS-BIS(DIMETHYLAMINE)DIAMMINE PLATINUM(II) CHLORIDE. Part II. Deuterium Exchange Reactions of Coordinate Beta-Diketonates of Cobalt(III). Collins, R. N. Fayetteville, AR; Univ. of Arkansas (1973). 135p. University Microfilms Order No. 73 27,412.

Thesis (Ph. D.).

The polarized single crystal spectra of trans-$[Pt((CH_3)_2NH)_2(NH_3)_2]Cl_2$ were measured at 297, 88, 22, and 5°K. Because of the similarity between the solution and crystal spectra, the data were analyzed using an oriented gas model. The deuterium exchange rates at the γ-carbon of some cobalt(II) acetylacetonates have been measured in deuterium oxide buffers. Kinetic data were obtained using NMR techniques for bis(ethylenediamine) acetylacetonato cobalt(III) nitrate and ethylenediamine bis(acetylacetonato) cobalt(III) nitrate which show the reaction to be first order in complex, but gives an order less than one for the deuterium ion dependence, suggesting a pre-equilibrium step in the mechanism. The specific velocity constants (k) for deuterium exchange rates are 5×10^{-4} and 3×10^{-4} respectively and the rate law consistent with such a mechanism is Rate = kK_{eq}-[complex]-$[^2H^+]/(1 + K_{eq}[^2H^+])$. (LK)

Feed Materials Processing

Refer also to abstract 4833.

4879 (INIS-mf-165/13) SOME NEW RESULTS OF PERCOLATION LEACHING OF HUNGARIAN LOW-GRADE URANIUM ORES. Czegledi, B.; Egyed, J.; Stocker, L.; Laboda, T.; Budavari, A. (Mecseki Ercbanyaszati Vallalat, Pecs II (Hungary)). 1970. 13p. (In Czech). INIS.

Hungarian experience is reviewed from soda percolation leaching of low-grade uranium ores. The experience was gained partly in operation and partly in research work. The results indicate that waste material containing 0.005 to 0.007% uranium can be economically treated. At present, 1.5 million tons of low-grade uranium ores are treated by this method. Applying the results of research and other measures can increase the envisaged yield of 50% to between 70 and 80%. (INIS)

4880 (JEN-271) STATIC LEACHING OF URANIFEROUS SHALES IN OPEN AREAS. Hernandez Nieto, J.; Cordero, G.; Villarrubia, M. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 25p. (In Spanish). Dep. NTIS (U.S. Sales Only) $3.25.

Tests on acid heap leaching with conventional (1.400 ppM U_3O_8) crushed uranium ores are described. Open circuits with low internal recycle are used. By control of the acidity in the leaching solutions we can obtain a smooth solubilization of uranium and, at the same time, the pregnant liquors are good for the solvent extraction recovery. The results show a saving of the acid consumption, and also high recovery of uranium. (auth)

4881 (JEN-272) STATIC LEACHING OF URANIUM ORE CONTAINING CLAY. Gonzalez, E.; Sedano, A. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 19p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

An experimental facility, built near "El Lobo" mine, is described. The beneficiation of low-grade uranium ore containing clay and fines is studied. The flowsheet consists of four steps: static leaching, pH adjustment, ion exchange, and precipitation. (LK)

Radiation Chemistry

Refer also to abstracts 4929, 5203, 5469, 5689, and 7418.

4882 (AAEC/LIB/Bib-395) EFFECT OF RADIATION ON AQUEOUS CYANIDE SOLUTIONS. A Bibliography, 1957 to 1972. Geue, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

Seventy-two references are arranged alphabetically by author within each year. A supplement of thirty-two references on reviews, bibliographies and general articles on radiation chemistry of aqueous solutions is included. (AT)

4883 (AERE-R-7504) MICROSCOPIC EXAMINATION OF GRAFT COPOLYMERISATION OF ACRYLAMIDE PAPER. Macphail, I.; Verdin, D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1973. 18p. Dep. NTIS (U.S. Sales Only) $3.00. UK 50 pence.

It has been established that conventional metallographic techniques can be adapted to the preparation of samples of paper for examination by light and scanning electron microscopes. The structure of filter paper radioinduced graft copolymerised with acrylamide has been examined. (auth)

4884 (CEA-CONF-2325) PERMSELECTIVE MEMBRANES MADE BY GRAFTING THIN FILMS OF POLYESTER AND SILICONE. Homogeneous Graft Membranes. Inert and Active Porous Membranes. Marchand, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). 7 Mar 1973. 41p. (In French). (CONF-730343-3). Dep. NTIS (U.S. Sales Only) $4.25.

From meeting on the development of industrial applications of radiation chemistry; Paris, France (13 Mar 1973).

Different structured membranes were obtained. Gamma radiation is used to implant the packets of polyelectrolytes in the texture of a crystalline polyester film or in the bulk of a porous silicone elastomer. Heavy ionizing particles are used to obtain a porous material with cylindrical shaped pores having diameters determined by the chemical development conditions. In this last case, the utilization of the species created by the passage of the particles to fix the polyelectrolyte results in its distribution in the walls of the pores after it has produced the porosity. The first ion exchange membranes exhibited interesting properties for small thicknesses. The second ion exchange membranes, which are porous particularly when the pores are coated with a polyelectrolyte, suggest applications in separation using fine filtration or ultrafiltration. (FR)

4885 (CONF-711081--) POLYMERS 71 SYMPOSIUM, VARNA, OCTOBER 7-10, 1971. (AN Latvijskoj SSR, Riga. Inst. Khimii Dreveseiny). 1971. 280p. (In Several Languages).

From polymers '71 symposium; Varna, Bulgaria (7 Oct 1971).

4886 (DSL-TN-298) SOME REACTIONS OF ORGANOTIN COMPOUNDS UNDER GAMMA-IRRADIATION. Dunn, P.; Oldfield, D. (Defence Standards Labs., Maribyrnong (Australia)). Apr 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

Reaction of organotin compounds with pentafluorobenzene under the influence of gamma-radiation produces organotin fluorides. (auth)

4887 (NP-19852, pp 108-109) RADIOLYSIS OF BINARY MIXTURES OF TETRAHYDROFURAN AND BENZENE IN HIGH LET REGION. Matsui, M.; Karasawa, T.; Imamura, M. Dec 1972.

4888 (NP-19852, pp 110-113) LET DEPENDENCE OF SPATIAL DISTRIBUTION OF FREE RADICALS IN IRRADIATED CRYSTALLINE EICOSANE. Kimura, K.; Kikuchi, M.; Matsui, M.; Karasawa, T.; Imamura, M.; Tabata, Y.; Oshima, K. Dec 1972.

4889 (USC-113-P-21-X-7) ESR STUDIES OF THIYL FREE RADICALS IN RELATION TO BIOLOGICAL EFFECTS OF RADIATION. Wolf, W. (University of Southern California, Los Angeles (USA)). 15 Aug 1973. Contract AT(04-3)-113. 24p. Dep. NTIS $3.25.

Research progress is reported on ESR studies of thiyl free radicals with emphasis on computer analysis of the ESR spectra; variable temperature studies; properties of radicals related to RS; further studies on the nature of the "I" signal and the possible use of cerium ions as "G-shift reagents" to identify radical ions related to the thiyl free radical; regulation of oxygen concentration; hindered internal rotation in the glutathione thiyl free radical; and determination of thermodynamic parameters. (DHM)

4890 ELECTRON SCAVENGING IN THE RADIOLYSIS OF SUPERCRITICAL PROPANE AND PROPYLENE: EFFECT OF DENSITY. Yamaguchi, Y.; Nishikawa, M. (Department of Pure and Applied Sciences, University of Tokyo, 3-8-1 Komaba, Meguro-ku, Tokyo, Japan). J. Chem. Phys. 59: No. 3, 1298-1303 (1 Aug 1973).

The nitrogen yield observed upon electron scavenging by N_2O in the γ radiolysis of supercritical propane and propylene at 120 °C and at various densities can be quantitatively described by the square root model, $G(N_2) = G(N_2)_s + G(N_2)_s(A[N_2O])^{1/2}$, in the lower concentration range. $G(N_2)_s$ decreases smoothly with increase in density in both hydrocarbons. At a given density, $G(N_2)_s$ in propane is always larger than that in propylene, e.g., at d = 0.35 g/ml, $G(N_2)_s = 1.13$ and 0.36, respectively. The analysis of $G(N_2)_s$ on the assumption $G(N_2)_s = G$(free ion) indicates that (i) the density-normalized range of electrons is constant over the density range of 0.24-0.42 g/ml in propane and 0.12-0.44 g/ml in propylene, and (ii) the efficiency of electron thermalization in propylene is about twice as good as in propane. The results are related to the thermalization mechanisms of electrons in hydrocarbons. An interpretation of the change in values of A with density is given in terms of the change in the distribution function of ion-electron separation distances and the diffusion coefficient of electrons. (auth)

4891 NEUTRON IRRADIATION OF MERCURY IN POLYETHYLENE CONTAINERS. Weiss, H. V. (Naval Undersea Center, San Diego, CA); Chew, K. Anal. Chim. Acta; No. 67, 444-447(1973).

Behavior of mercury on neutron irradiation in polyethylene containers was studied. Mercury in acidified solution can be bombarded in a flux of $2 \cdot 10^{12}$ n cm^{-2} s^{-1} for 10 to 60 min without loss. In the absence of acid, substantial loss occurs from adsorption on the walls of the irradiation vial (12%) and volatilization (18%). (LK)

4892 GAMMA IRRADIATION STUDIES WITH SYNTHETIC POLY-L-LYSINE HYDROBROMIDE. Joshi, S. V. (Tata Memorial Centre, Bombay). Indian J. Biochem. Biophys.; 9: 341-344(Dec 1972).

Effect of ^{60}Co gamma irradiation on dilute aqueous solutions of poly-L-lysine hydrobromide (50 μg/ml) in the dose range 1.6×10^4 rad to 6.0×10^4 rad has been investigated. Monolayer data using Langmuir's surface balance with 0.2M phosphate buffer +4% NaCl at pH 6.0 as subphase are obtained. Attack on the side groups in the form of deamination as well as reduction in carbon chain length is indicated. Conversion of some lysine residues into threonine has been identified by thin layer chromatography and automatic amino acid analysis. Ultraviolet spectral absorption, gel filtration, as well as monolayer data suggest relative radiostability of the peptide bond under the irradiation conditions employed. (auth)

4893 CHANGES IN POLY(VINYLIDENE FLUORIDE) UNDER THE ACTION OF GAMMA RADIATION. Berlyant, S. M.; Gavlovskii, A. A.; Karpov, V. L. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. B; 15: No. 7, 524-527(Jul 1973). (In Russian).

Samples of three crystalline forms of poly(vinylidene fluoride) (PVF), prepared by compression of powder at 200°C, were gamma irradiated (^{60}Co) at room temperature in a vacuum to absorbed radiation doses of up to 900 Mrads. The results of differential thermal analysis indicated a more rapid conversion of the crystalline material to amorphous than had been indicated by x-ray analysis. The explanation is that the intermolecular cross-linking induced by the radiation not only decreases the crystallinity but also limits the mobility of the molecules, which in turn decreases the heat effect. However, the amount of the cross-linking is insufficient to damage the ordering significantly. (TTT)

4894 EPR STUDY OF PARAMAGNETIC CENTERS IN GAMMA IRRADIATED FLUORINE- AND HYDROGEN-CONTAINING POLYMERS. Bobyleva, A. V.; Berlyant, S. M.; Klinshpont, E. R. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. B; 15: No. 7, 527-531(Jul 1973). (In Russian).

Poly(vinylidene fluoride) (PVF), copolymer of tetrafluoroethylene with ethylene (1:1) (SF-1) and copolymer of tetrafluoroethylene with vinylidene fluoride (1:1) (SF-2) was gamma-irradiated at 77°K. The number of paramagnetic centers formed varied linearly with the radiation dose from 0 to 10 Mrads in all three materials, with the slope of the line increasing from PVE to SF-1 to SF-2. The radiation yield increased with the introduction of a small amount of hydrogen into the fluorine-containing chain, but a high hydrogen content decreased the radiation yield. Exposure to light resulted in recombination of charged particles of different signs. EPR spectra are shown for all three materials irradiated with 1, 7, 15, and 20 Mrads. (TTT)

4895 RADIATION-INDUCED POLYMERIZATION OF A SERIES OF ALKYL VINYL ETHERS. Goineau, A. M. Raleigh,

NC; North Carolina State Univ. (1972). 123p. University Microfilms Order No. 73-26,744.

Thesis (Ph. D.).

A laboratory investigation into the field of new monomers polymerizable by γ rays was carried out as part of a larger engineering project. To cope with the sensitivity of radiation-induced polymerization to moisture, a fast and versatile technique to "super-dry" monomers was successfully developed using for the first time molecular sieves as drying agent. A series of alkyl vinyl ethers was found particularly attractive, and a comparative kinetic study of them was conducted to assess the structural effect of the alkyl group on polymerization rates. A kinetic analysis of the rate data by computer using Williams's model of free ion polymerization was devised and successfully tested with literature data, in order to obtain comparable kinetic values from the experimental data. (Diss. Abstr. Int., B)

4896 ELECTRON MICROSCOPE OBSERVATIONS OF THE GRAFTING DISTRIBUTION INITIATED BY HEAVY IONIZING PARTICLES IN A POLYMER FILM AND THE NEW TYPE OF MEMBRANE PRODUCED. Marchand, J.; Puig, J. R. (Cen de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 276: No. 26, 1771-1774(25 Jun 1973). (In French).

The distribution of grafted zones in the volume of a polymer film poly(ethylene glycol terephthalate) was studied. As a result of grafting with acrylic acid or vinylpyridine induced by γ radiation, copolymer microphases orientated parallel to the stretching axis of the film are formed. Grafting initiated by accelerated heavy ions results in a copolymer distributed continuously along a layer covering the inner wall of the microchannels as well as the surface of the film. (Fr)

4897 DIFFERENTIAL THERMAL ANALYSIS OF POLYTETRAOXANE OBTAINED BY RADIATION-INDUCED POLYMERIZATION IN THE SOLID STATE. Nakase, Y.; Kuriyama, I. (Japan Atomic Energy Research Inst., Tokai). Polym. J.; 4: No. 5, 517-525(May 1973).

Differential thermal analysis was carried out on poly(oxymethylene) [polytetraoxane] obtained by radiation-induced polymerization of tetraoxane in the solid state. The profile of the melting endotherm is related mainly to the polymer yield and the melting point mainly to the molecular weight of the polymer obtained. The degradation of the polymer chain during the polymerization in air causes the destruction of the polymer crystal formed and produces various types of crystallite. Polytetraoxane crystals are easily annealed above 160°C; i.e., at the temperature range from 160 to 170°C crystals of higher melting point are obtained after rearrangement; at the range from 170 to 180°C, a new endotherm, probably of the new crystal formed after the partial melting, is observed at about 165°C, and at the range from 180 to 187°C, a single endothermic peak, probably of the crystal formed after the wide range partial melting, is observed at a lower temperature than that of the melt-crystallized sample. It is suggested that the original polymer crystal may be of the extended chain structure which the crystal rearranges, and that the new crystal formed after the annealing above 170°C may be of the folded chain structure. (auth)

4898 RADIOTHERMOLUMINESCENT STUDY OF MOLECULAR MOVEMENT IN POLYETHYLENE AT LOW TEMPERATURES. Aulov, V. A.; Sukhov, F. F.; Slovokhotova, N. A. (Scientific Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 15: No. 8, 615-616(Aug 1973). (In Russian).

The radiothermoluminescence of linear polyethylene (in powder form) was studied at temperatures from 4 to 220°K. Two closely placed maxima appeared at 110–120°K (δ max.) and one at 180°K. With less than 1 Mrad radiation, the first maximum in the doublet was more intense but, with >4 Mrads, the second component dominated. The location of the δ maximum could be defined by a linear relation with the logarithm of the heating rate of the polymer in the range from 3 to 150 deg/min. A preliminary orientation (1500% extension at 95°) and cross-linking (300 Mrads in a vacuum) of the polyethylene film resulted in displacement of the δ maximum to temperatures of 3 and 10° higher, respectively. (TTT)

4899 UNSTABLE INTERMEDIATES. CXXXIV. Electron Spin Resonance Studies of Positive Hole Centres in γ Irradiated Glycine. Serdobov, M. V.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Perkin Trans., II; No. 13, 1808-1811(1973).

Single crystals and powders of α-glycine, N-deuterioglycine, and C-deuterioglycine have been exposed to ^{60}Co γ rays at 77°K, and their ESR spectra studied as a function of annealing temperature. Initial radical products comprised $H_3^+NCH_2CO_2^-$, $H_3^+NCH_2CO_2^-$, and $H_3^+N\dot{C}H_2$. On annealing, $H_3^+NCH_2CO_2^-$ gave $H_2\dot{C}CO_2^-$ radicals, $H_3^+NCH_2CO_2^-$ probably gave $H_3^+N\dot{C}HCO_2^-$ radicals, while $H_3^+N-\dot{C}H_2$ gave H_2NCH_2. On further annealing intermolecular attack gave mainly $H_3^+NCHCO_2^-$ radicals. (auth)

4900 STABILIZATSIYA RADIATSIONNO-MODIFITSIROVANNYKH POLIOLEFINOV. (Stabilization of Radiation-Modified Polyolefins). Braginskii, R. P.; Finkel, E. E.; Leshchenko, S. S. Moscow; Izdatel'stvo Khimiya (1973). 200p.

Radiation-modified polyolefins are polymeric materials which, due to their good performance, are finding wide use in industry, especially in cables. A disadvantage of these materials is their oxidizability at high temperatures. Therefore, it is essential that they be protected from oxidants. Aging and stabilization of irradiated polymers are discussed. New data on the effect of stabilizers on structure formation in polyolefins, the relation between the type of submolecular structure, the thermostability of irradiated polyolefins, and methods for protecting them from oxidation at high temperatures are discussed. The book is designed for a wide variety of research workers, workers in physics and chemistry of polymers, radiation chemistry, and related fields. (tr-auth)

4901 RADIOINDUCED CROSSLINKING OF POLY(VINYLIDENE FLUORIDE). Makuuchi, K.; Seguchi, T.; Suwa, T.; Abe, T.; Tamura, N. (Japan Atomic Energy Research Inst., Takasaki). Nippon Kagaku Kaishi; 1973: No. 8, 1574-1581(Aug 1973). (In Japanese).

The radiation-induced crosslinking, chain scission, and oxidation of poly(vinylidene fluoride) (PVdF) have been studied. The irradiation was carried out with γ rays and electron beams at ambient temperature under vacuum and in the presence of oxygen. The gel formation, solution viscosities, and number average molecular weight of the PVdF so treated, as well as the evolution of hydrogen fluoride (HF) and other gases were measured. IR and UV spectra were also obtained. When PVdF was irradiated under vacuum, the G value for crosslinking was 0.6 ~ 0.8. This was equal to the G value for chain scission. Double bonds including polyenes were formed as a result of dehydrofluorination. The concentration of polyenes was, however, low and decreased with increase in the number of conjugated unsaturation. Polyenes longer than tetraene were hardly observable. The G value for the formation of HF was reduced from 3.5 to 3.0 when HF was removed with dry potassium hydroxide during irradiation. This result suggests the accelerating effect of HF on the radiolytic dehydrofluorination of PVdF. Oxygen accelerated the chain scission and dehydrofluorination of PVdF. Those effects are dependent on dose rate and the thickness of samples. At high dose rate (electron beams), there was little effect, while the remarkable effect was observed at low dose rate; the thinner the sample the more the effect. Carbonyls such as acid fluoride and carboxylic acid were detected as the oxidation products. The reaction mechanism is discussed in connection with the results obtained here and ESR measurement. (auth)

4902 GAMMA-INDUCED PREPARATION OF ION EXCHANGER. Yamagami, M.; Fukumoto, T.; Tsurugi, J. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 108-110(Mar 1973).

Gamma-induced copolymerization of styrene (M_1) and dialkyl vinylphosphonates (M_2), which were prepared by γ-induced addition reaction followed by thermolysis of the adduct, was studied. When initial molar ratio, M_1/M_2 is 0.2, copolymers of styrene and dialkyl vinylphosphonates contained about 50 : 50 molar ratio. Monomer reactivity ratios r_1 and r_2 were calculated to be 0.4 and 0, respectively. Hydrolysis of the copolymer with hydrochloric acid gave vinylphosphonic acid-styrene copolymer with 83~86 % efficiencies. This functional polymer is expected to be utilized for cation-exchanger. (auth)

4903 AFTER-EFFECT OF PRESSURE TO THE ESR SPECTRA OF IRRADIATED PMMA. Tino, J.; Szocs, F. (Polymer Inst., Bratislava). Polym. J.; 4: No. 2, 120-123(Feb 1973).

Changes in the structure of 9-line ESR spectrum of irradiated PMMA to which the pressure of 5000 atm has been applied are studied. The original 9-line spectrum gradually changes so that other component spectra (i.e., singlet, doublet, and quartet) start to prevail. These spectra correspond to polyene radicals, chain radicals of the type $-(CH_3)C(COOCH_3)-\dot{C}H-(CH_3)C(COOCH_3)-$ and allyl radicals. (auth)

4904 MECHANISM OF RADIATION CHEMICAL DEHYDROGENATION OF ALKENES. Cserep, G.; Foeldiak, G. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 77: No. 4, 407-416(1973).

The radiation chemical dehydrogenation of alkenes takes place essentially in accordance with the energies of the C–H bonds: it occurs with greater probability for smaller energies of a given bond type. Hydrogen formation is determined fundamentally by the nature of the C–H bonds in the allylic position and increases in the order primary < secondary < tertiary. For aliphatic alkenes the $G(H_2)$ value can be estimated from the average specific $G(H_2)/H$

values calculated for the different C–H bonds on the basis of measured hydrogen yields. For cyclic alkenes, however, owing to the steric arrangement of the ring structure, the $G(H_2)$ values calculated in this way show significant deviations from the measured values, and seem to disappear and tend to approach those of the corresponding aliphatic analogues, only if the number of C atoms in the ring becomes higher than ~ 12. (auth)

4905 ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED KH_2PO_4. Tsuchida, K.; Abe, R.; Naito, M. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 3, 806-809(Sep 1973).

ESR spectra of γ-irradiated KDP were measured at both X and K bands. The radical was ascertained to be $\cdot OPO_2H^-$ which resulted from the loss of a hydrogen atom from a $H_2PO_4^-$ ion. The principal values of g-tensor of the radical were determined to be 2.054, 2.007, and 2.003, and those of A-tensor to be 36.8, 33.8, and 33.0 G. From the analysis of the anisotropic g-tensor, it was concluded that the PO_4 tetrahedron in the radical was rotated by about 13° around the c-axis from the original position. The spectrum of irradiated DKDP can be explained consistently with the result if the unpaired electron is distributed equally on four oxygens. (auth)

4906 NUCLEAR MAGNETIC RESONANCE ABSORPTION OF POLYTETRAFLUOROETHYLENE GAMMA-IRRADIATED AT HIGH TEMPERATURES. Tutiya, M. (Tokyo Metropolitan Isotope Research Center). Jap. J. Appl. Phys.; 11: No. 10, 1542-1546(Oct 1972).

The NMR spectra of PTFE irradiated at various temperatures with a dose of 1.1×10^7R and irradiated at 340°C with various doses were measured over the temperature range from –50°C to 50°C. In the case of PTFE irradiated with 1.1×10^7R, the percent crystallinity estimated from NMR spectra increased with increasing irradiation temperature up to about 300°C, but decreased abruptly above 320°C, and increased again. In the case of PTFE irradiated at 340°C, the crystalline transition temperature was shifted to a lower temperature at 1.1×10^7R and the NMR line shape changed into a single component at 1.1×10^8R. The crystal imperfections due to irradiation at 340°C were caused by high viscosity during irradiation, occlusion of low molecular degradation products, the low degree of chain fractures and probably by the structure changes such as branches and crosslinkings. (auth)

4907 KINETICS AND MECHANISM OF THE RADIATION IONIC GRAFT POLYMERIZATION. Kabanov, V. Ya.; Sidorova, L. P.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 4, 889-892(1 Aug 1973). (In Russian).

Experiments on radiation grafting of styrene to high-density polyethylene, using carefully dried materials, verified the validity of a suggested ionic mechanism of radiation-grafted polymerization of styrene. Twelve cationic and anionic reaction mechanisms are presented. (tr-auth)

4908 MO-CALCULATIONS ON THE STABILITY OF THE H_3O RADICAL IN WATER. Efskind, L. (Norsk Hydros Institutt for Kreftforskning, Oslo). Acta Chem. Scand.; 26: No. 10, 4147-4156(1972).

MO calculations by the INDO method were performed for the H_3O free radical and some of its water complexes. Calculations on the corresponding H_3O^+ ion complexes were included for comparison. It was found that the H_3O radical is stable against bond dissociation to H_2O and H, but unlike the ion it is destabilized by the surrounding water complexes. (auth)

4909 PRIMARY SPECIES YIELDS IN THE ^{60}Co γ RAY RADIOLYSIS OF AQUEOUS SOLUTIONS OF H_2SO_4 BETWEEN pH 7 AND 0.46. Sehested, K.; Bjergbakke, E.; Fricke, H. (Danish Atomic Energy Commission, Risoe). Radiat. Res.; 56: No. 2, 385-399(Nov 1973).

$G(H_2O_2)$ was measured in aqueous solutions containing different low concentrations of $O_2 + Br^-$ and $G(H_2)$ was measured in dilute solutions of KBr at different pH values between 7 and 0.46. Assuming material balance for the primary species from water and using earlier measurements of $G(H_2O_2)$ from solutions of $H_2 + O_2$, the zero scavenger concentration primary yields $G^0_{e^-_{aq}+H}$, $G^0_{H_2}$, G^0_{OH}, and $G^0_{H_2O_2}$ from water, were calculated between pH 7 and 1. Precise values for these yields cannot be obtained at pH 0.46 because of the complications from the direct absorption of the γ-rays in H_2SO_4. The resulting principal molecular product is peroxymonosulfuric acid, for which the yield $G(H_2SO_5) = 0.06$ was measured. The yield of peroxydisulfuric acid was negligible. The primary species yield from water were confirmed at pH 1.51 to 0.46 by measuring G[Ce(III)] and $G(O_2)$ in the gas-free Ce(IV) + Ce(III) system, and between pH 2.74 and 0.46 by application of G[Fe(III)] measured at different low concentrations of O_2 in 0.1 mM $FeSO_4$ and extrapolated to zero concentration of O_2. Further confirmation was obtained at pH 7 from the radiolytic decomposition of the gas-free H_2O_2 system, for which reaction earlier workers obtained considerably lower yields than expected from the present study. The disagreement was eliminated by introducing various improvements in the experimental techniques. (auth)

4910 RADIATION DECOMPOSITION OF PHOSPHOROTHIOATE PROTECTIVE AGENTS. Martin, D.; Kollmann, G.; Shapiro, B. (Albert Einstein Medical Center, Philadelphia). Radiat. Res.; 56: No. 2, 246-257(Nov 1973).

Aqueous buffered solutions of 2-(5-aminopentyl)aminoethyl phosphorothioate (WR-2823) and 2-(3-aminopropyl)aminoethyl phosphorothioate (WR-2721) as well as some of their "latent derivatives" (corresponding thiols and disulfides), labeled with ^{35}S and ^{32}P, were irradiated by a 400 Ci ^{137}Cs γ-ray source. The radiation products were separated, identified and measured quantitatively by paper chromatography. The radiolysis of these compounds brought about oxidation of the sulfur atom with subsequent dephosphorylation, and then further oxidation occurred to either the sulfonic acid or to inorganic sulfate. The oxidation of these radiation protective agents indicates that they are capable of reacting with radicals formed in irradiated aqueous solutions thus offering partial protection against irradiation induced changes. This protection was shown in two systems in vitro: (a) radiation-induced permeability of erythrocyte membranes and (b) radiation-induced decrease in specific viscosity of DNA solutions. (auth)

4911 ELECTRON DISAPPEARANCE IN PULSE IRRADIATED FLUOROCARBON GASES. Bansal, K.M.; Fessenden, R.W. (Radiation Research Laboratories, Center for Special Studies and Department of Chemistry, Mellon Institute of Science, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 59: No. 4, 1760-1768 (15 Aug 1973).

Rate constants for electron attachment to some highly reactive fluorocarbon gases have been determined by microwave conductometric methods. Initial ionization of the gas was by pulse radiolysis with 2.8 MeV electrons. To facilitate measurements on very reactive compounds a method has been developed which is applicable when the electron half-life is <1 μsec. This method uses the amplitude of the steady-state response of the detector during the pulse and the rate of production of electrons based on measurements on the nonattaching buffer gas alone. This steady-state method was tested on mixtures of CF_2Cl_2 or SF_6 in C_3H_8 and was shown to agree with direct measurements of the decay of the electron concentration. With propane as the buffer gas the method is applicable where the electron half-life is greater than about 0.5 μsec at 1 torr total pressure. At higher pressures of attaching gas decreases in apparent rate constant were observed which could be attributed to electron reaction before complete thermalization. Values for thermal attachment rate constants (cm^3 $molecule^{-1} \times sec^{-1}$) at 25 °C found in this work are 1.3×10^{-9} for CF_2Cl_2; 1.2×10^{-8} for cyclo-C_4F_8, 1.4×10^{-7} for cyclo-C_4F_6, and 4.9×10^{-8} for C_4F_8-2. In comparison to these values that for cyclo-C_3F_6 was determined to be $< 3 \times 10^{-14}$. Perfluoropropylene was found to undergo a transition from three- to two-body behavior at high pressures of buffer gas, and the rate constant values imply a negative ion lifetime near 1 μsec. The limiting value of the two-body rate constant was found to be 3×10^{-10} cm^3 $molecule^{-1} \times sec^{-1}$. (auth)

4912 OXIDATION AND REDUCTION OF BARBITURIC ACID DIHYDRATE BY IONIZING RADIATION AT 4.2 °K. Box, H.C.; Budzinski, E.E. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14203). J. Chem. Phys. 59: No. 4, 1588-1591 (15 Aug 1973).

The primary oxidation and reduction products produced by ionizing radiation in single crystals of barbituric acid irradiated at 4.2 °K have been identified from their ESR and ENDOR spectra. The primary reduction product is an anion formed by electron addition. The primary oxidation product is a neutral radical resulting from the loss of hydrogen from an >NH group. (auth)

4913 RADIATION DAMAGE PRODUCED IN SINGLE CRYSTALS OF N-ACETYLGLYCINE. Sinclair, J.; Codella, P. (Department of Chemistry and Biochemistry, Utah State University, Logan, Utah 84321). J. Chem. Phys. 59: No. 4, 1569-1576 (15 Aug 1973).

The chemical effects initiated by x irradiation in the simple peptide N-acetylglycine have been examined by electron spin resonance. The paramagnetic fragments produced in the temperature range 77–300 °K have been observed in irradiated single crystals of the peptide. Positive identification of the radicals have been made using isotopically labeled acetylglycines incorporating both carbon-13 and deuterium at selected sites. Proton and carbon-13 hyperfine tensors have been determined for most of the fragments, and a reaction scheme is presented which rationalizes the production of the observed species in terms of initially produced anion and cation radicals. (auth)

4914 RADIOLYSIS OF AMMONIA. Hamanoue, K.; Okamoto, J. (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 46: No. 9, 2871(Sep 1973).

Radiolysis of ammonia was studied extensively; the primary process of hydrogen formation was investigated in detail. It was concluded that the G values of nonscavengeable hydrogen molecules are 0.64-0.84 and those of scavengeable hydrogen radicals are 5-12. (LK)

4915 CALCULATION OF PRODUCTION RATES IN A RADIATION CHEMICAL REACTOR. Mulas, P. (Centro de Investigaciones y Estudios Avanzados, Mexico City); Ortiz, R. M. Trans. Amer. Nucl. Soc.; 17: 123-124(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4916 ELECTRON BEAM CROSSLINKING OF POLYMERS. Hoffman, C. R. (High Voltage Engineering Corp., Burlington, MA). Trans. Amer. Nucl. Soc.; 17: 130(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4917 EUROPEAN CENTER FOR R AND D IN RADIATION PROCESSING: CAPRI. Puig, J. R. (CEA, Saclay, France). Trans. Amer. Nucl. Soc.; 17: 130(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4918 INDUSTRIAL APPLICATION OF RADIATION CHEMISTRY IN JAPAN. Tabata, Y. (Tokyo Univ.). Trans. Amer. Nucl. Soc.; 17: 130(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4919 NEW WOOD-CHIP IRRADIATION PROCESS. Friend, R. G. (Radiation Development Co., Ltd., Vancouver, B. C.); Mitchell, G. W.; Hoffman, A. S. Trans. Amer. Nucl. Soc.; 17: 130(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4920 RADIATION CROSSLINKING OF POLYETHYLENE IN THE PRESENCE OF ACRYLIC ACID. Silverman, J. (Univ. of Maryland, College Park); Joshi, M.; Singer, K. Trans. Amer. Nucl. Soc.; 17: 130-131(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4921 NEW BIOCOMPATIBLE AND BIOFUNCTIONAL MATERIALS VIA A RADIATION GRAFTING/BIOCHEMICAL BONDING PROCESS. Hoffman, A. S. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 17: 131(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4922 RADIATION-INDUCED REACTION OF FLAME RETARDANTS IN CELLULOSIC FABRICS. Walsh, W. K.; Bittencourt, E.; Rutherford, H. A. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 17: 131(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4923 UNIQUE PROCESS DESIGN ASPECTS OF RADIATION POLYMERIZATION/COPOLYMERIZATION AND/OR GRAFTING IN EMULSION SYSTEMS. Stahel, E. P.; Stannett, V. T. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 17: 131(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4924 GAMMA RADIATION GRAFTING AND CHARACTERIZATION OF HYDROGELS. Lentz, D. J.; Andrade, J. D. (Univ. of Utah, Salt Lake City). Trans. Amer. Nucl. Soc.; 17: 132(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4925 SOLUBILITY OF KRYPTON AND XENON IN LIQUID CO_2. Notz, K. J.; Meservey, A. B.; Ackley, R. D. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 318-319(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiochemistry and Nuclear Chemistry

4926 (RFP-1921-A) RESEARCH AND ECOLOGY SEMIANNUAL PROGRESS REPORT, JANUARY–JUNE 1972. Chemistry Research and Development. Thompson, M. A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 30 Aug 1973. Contract AT(29-1)-1106. 47p. Dep. NTIS $3.00.

Research progress is reported in the following areas: chemistry research and development, chemistry instrumentation, process chemistry, chemical technology, and environmental research. (DHM)

Hot-Atom Chemistry

4927 (CONF-730961-1) STEREOCHEMISTRY OF THE DECAY-INDUCED HALOGEN EXCHANGE IN DIASTEREOMERIC ALKYL HALIDES IN THE GAS PHASE. Daniel, S. H.; Ache, H. J.; Stoecklin, G. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). 1973. 27p. Dep. NTIS $3.50.

From 7th international hot atom chemistry symposium; Jülich, F. R. Germany (10 Sep 1973).

The stereochemistry of the halogen for halogen substitution at asymmetric carbon atoms, induced by energetic or thermal bromine and iodine species was studied in diastereomeric alkyl halide molecules such as d,l- and meso-2,3-dichlorobutane. Energetic ^{80}Br species were generated via the ^{82m}Br (I.T.)^{80}Br nuclear process in reactor produced $CF_3{}^{80m}$Br and allowed to react with the substrate molecules while still possessing excess kinetic energy or after having become thermalized in collisions with argon atoms. ^{125}I species were produced via the radioactive decay of ^{125}Xe. The observed results show in unmoderated systems generally a predominance of those products which were formed in the halogen for halogen exchange process under retention of configuration. (auth)

4928 I. SCAVENGER COMPETITION IN RECOIL HOT TRITIUM ATOM CHEMISTRY. II. Chemical Accelerator Studies of Hot Tritium Atom Reactions in the Gas Phase. Hall, R. B. New Haven; Yale Univ. (1973). 237p. University Microfilms Order No. 73-26,288.

Thesis (Ph.D.).

The effects of hot reaction with the scavenger on the (hot) product yields of some recoil tritium–hydrocarbon reactions were studied. A formalism was developed that allows the hot product yields to be corrected for scavenger effects with a minimum of experimental information. The parameters needed for this correction and tables of previous data, adjusted for this "scavenger competition," are presented. The systems studied include methane (both Br_2 and I_2 scavengers) and ethane (Br_2 scavenger), moderated by xenon, neon and argon. The dependence of the scavenger competition on the moderator is demonstrated and corrected kinetic theory parameters for these systems are presented. Experiments performed in CD_4 (Br_2 scavenged) systems, xenon and argon moderated, unlike those above, result in product yields that do not fit into the framework of the kinetic theory. Several possible explanations for this behavior are proposed. The tritium accelerator, "Adam," has been modified to allow the study of gas phase reactions of fast neutral tritium atoms. The apparatus is described and preliminary results on the reactions of 150 eV tritium neutrals (and ions) on C_2D_6 are presented. Both abstraction and displacement yields are measured and the variation in the product ratios as a function of the presence of helium moderator and of the charge state of the tritium beam is determined. The stabilization to decomposition ratio of the excited parent agrees well with an extrapolation of previous "high" pressure results, implying that there are few longer lived excited displacement products. The product ratios for T^+ beams are very similar to those for neutral beams, with or without helium moderator. This tends to disprove the previous rationalization that the "anomalous" recoil tritium results in helium are due to ion reactions. The abstraction/displacement

ratio decreases with addition of helium. This implies that, despite recoil results to the contrary, the behavior of helium is similar to the other rare gases and that the average reaction energy for abstraction exceeds that for displacement. (Diss. Abstr. Int., B)

4929 FORMATION OF ORGANIC IODIDES IN SOLID BENZENE IRRADIATED WITH I^+ AND I_2^+ IONS. Akcay, H.; Cailleret, J.; Abbe, J. C.; Paulus, J. M.; Llabador, Y. (Centre National de la Recherche Scientifique, Strasbourg). J. Chim. Phys.; 70: No. 6, 970-972(Jun 1973). (In French).

The yields of C_6H_5I formed during the irradiation of solid benzene with I^+ or I_2^+ ions in the energy range from 10 eV to 2 keV were measured. The organic yields increase with the energy: at 2 keV they reach respectively 5% and 4% for I^+ and I_2^+. These values are an order of magnitudes lower than those obtained after nuclear transformations. These discrepancies are attributed to the radiolytic effects brought about by the formation of nucleogenetic atoms (especially by Auger electrons). (Fr)

4930 EFFECTS OF INELASTIC PROCESSES ON THE COLLISION DISTRIBUTION IN RECOIL SYSTEMS. Malerich, C.J.; Spicer, L.D. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112). J. Chem. Phys. 59: No. 4, 1577-1581 (15 Aug 1973).

The collisional distribution function for recoil hot atom systems is examined to determine the influence of specific inelastic processes on the collision density over the reactive energy range. The inelastic processes considered result from collisional dissociation of target molecules. In the case of recoil tritium reaction with deuterium gas, it was found that the collisional distribution function was shifted significantly due to dissociative collisions. The modified collision density incorporating inelastic events was used in this system to calculate the hot yields of DT as a function of inert gas moderation for comparison with experimental data. Both the magnitude and shape of the experimental yield curve were well represented over the entire range of moderator concentrations. (auth)

4931 REACTIONS OF ^{82}Br ACTIVATED BY ISOMERIC TRANSITION IN CH_4: A RE-EVALUATION. Helton, R. W.; Oates, D. W.; Rack, E. P. (Univ. of Nebraska, Lincoln). Bull. Chem. Soc. Jap.; 46: No. 9, 2877-2878(Sep 1973).

The effect of argon moderator on individual product yields of isomeric transition activated ^{82}Br in CH_4 was studied. Values of total organic yield extrapolated to zero mole fraction varied among laboratories. A re-evaluation of the system showed that the moderator-sensitized radiation damage was caused by irradiating the premixed sample instead of making the Br_2 radioactive and then mixing the components. (LK)

Properties of Radioactive Materials

Refer also to abstracts 4789, 4815, 4872, and 5383.

4932 (AERE-R-7480) TECHNIQUES FOR RECORDING SOLID STATE TRANSMISSION SPECTRA OF RADIOACTIVE COMPOUNDS. Brown, D.; Whittaker, B.; Edwards, J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Methods are described for recoiling solid state transmission spectra using 1 to 10 mg of radioactive actinide compounds in the range 0.2 to 2.2μ ($5f^n \rightarrow 5f^{n-1}6d$ and $5f^n \rightarrow 5f^n$ transitions). Factors that influence the quality of the spectra are discussed. (auth)

4933 (NP-19852, pp 104-105) RADIOCHEMICAL STUDY OF OXIDATION STATES OF ^{119}Sb AFTER THE EC DECAY OF ^{119m}Te IN TeO_2 AND H_6TeO_6. Ambe, S.; Ambe, F.; Saito, N. Dec 1972.

4934 (T-743, pp 3.49-3.64) TECHNIQUES FOR RAPID RADIOCHEMICAL SEPARATIONS. Menke, H. (Univ., Mainz). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Research is reported on techniques for rapid radiochemical separation in the following areas: separation methods for zirconium and technetium based on solvent extraction into quasi solid solvents; hydride volatilization for arsenic; and volatilization of fission products from solid uranium tetrafluoride. (DHM)

4935 BIS- AND TRIS-OXALATO COMPLEXES OF URANYL ION. Satpathy, K. C. (Sambalpur Univ., India); Meher, F. M.; Sahoo, B. Indian J. Chem.; 11: No. 7, 686-688(Jul 1973).

Bis- and tris-oxalato dioxo-uranium(VI) complexes with hydrazinium, methyl ammonium, ethylammonium, ethylenediammonium, hydroxylammonium and propylenediammonium have been prepared and their properties have been studied. IR spectra of the complexes indicate chelate structure for these compounds where uranium atom is 8-coordinated. (auth)

4936 FLUORO COMPLEXES OF URANIUM(IV). III. Pentafluoro, Hexafluoro and Enneafluoro Complexes of Uranium(IV). Satpathy, K. C. (Sambulpur Univ., Burla, India); Sarangi, D.; Sahoo, B. Indian J. Chem.; 11: No. 7, 681-682(Jul 1973).

A number of pentafluoro, hexafluoro, and enneafluoro complexes of uranium(IV) with trimethylammonium, triethylammonium, o-phenylenediammonium, isoquinolinium, 2-methylquinolinium, 2-aminopyridinium and 4-aminopyridinium ions have been synthesized and characterized. The complexes have been isolated from aqueous solution by the addition of the corresponding organic base with hydrofluoric acid, to a photochemically reduced uranium(IV) solution. (auth)

4937 DETERMINATION OF THE COMPOSITION OF THE U_3O_8 PHASE FROM THE DECOMPOSITION OF β-UO_3. Ramakrishnan, E. S. (Bhabha Atomic Research Centre, Bombay). Anal. Chim. Acta; 67: 209-212(1973).

It is known that the U_3O_8 phase exhibits some oxygen deficiency at high temperatures, but the exact phase-boundary composition and other thermodynamic data are lacking. A knowledge of the exact composition of this phase in air is essential, because the simple oxidation of urania phases in air to U_3O_8 is used as a method for the determination of oxygen/uranium ratios. The nonstoichiometry of the U_3O_8 phase has been demonstrated by oxidizing urania between 400 and 835°. The present work was undertaken to establish whether these observed compositions represented equilibrium compositions or were kinetically limiting compositions. The U_3O_8 phase was produced by decomposing β-UO_3 in air at 650, 750 and 850° and the resultant product was analyzed. (auth)

4938 CHEMISTRY OF URANIUM FLUORIDES AND OXIDE FLUORIDES. Part 1. Preparation and Vibrational Spectra of Uranium Oxide Tetrafluoride. Jacob, E. (Univ., Ulm, Ger.); Polligkeit, W. Z. Naturforsch., 28b: No. 3-4, 120-124(1973). (In German).

The new compounds UOF_4 and $U^{18}OF_4$ have been prepared by the hydrolysis of UF_6 with a solution of 0.1 to 0.2% H_2O and $H_2{}^{18}O$ in liquid HF. Properties and vibrational spectra are reported and discussed. (GE)

4939 ELECTRON EXCHANGE REACTION BETWEEN URANIUM(V) AND TIN(II) IN N-METHYLACETAMIDE WATER SOLUTIONS. Mayhew, R. T. Fayetteville, AR; Univ. of Arkansas (1973). 170p. University Microfilms Order No. 73-27,414.

Thesis (Ph.D.).

The electron exchange reaction between uranium(VI) and tin(II) was studied in 100% water solutions and in a mixed solvent system of 0, 20, 40, 65 and 80 wt % N-methylacetamide (NMA) and water. The reaction was studied at three temperatures 30, 40, and 50°C and at eight acid concentrations 1.00, 1.28, 1.62, 2.00, 3.00, 4.00, 5.00, and 6.00 M HCl in water. An oscillatory relationship was observed in a plot of the log of the second order rate constant versus the log of the hydrogen ion concentration. Iron and copper salts were shown to catalyze the reaction and a one electron step mechanism for catalysis was proposed. The high dielectric constant solvent NMA was used to prepare a series of mixed solvents to study the effect of changing dielectric on the system. The reaction followed second order kinetics in all the mixed solvents. For each concentration of acid studied, the increase in NMA in the system caused a sharp initial decrease in the rate. A minimum in the decrease was observed for 4M and 6M HCl. A unique preparation of the compound $(NMA)_2 \cdot HCl$ was discussed. (Diss. Abstr. Int., B)

4940 DEVELOPMENT OF RADIOACTIVE MEDICAL SUPPLIES. Takino, H. (Dainabot Radioisotope Labs. Ltd., Tokyo). Genshiryoku Kogyo; 19: No. 7, 27-30(Jul 1973). (In Japanese).

In February, 1973 the Welfare Ministry of Japan partially revised the regulations for manufacture of radioactive medical supplies and added 17 nuclides. Technetium-99m was approved officially as a radioactive medical preparation. Technetium-99m compounds are prepared by adding $^{99m}TcO_4$ solution to reagents. An electrolytic method was developed that enables the labeling of a number of compounds including ^{99m}Tc–Sn colloid and ^{99m}Tc albumin. New radioactive medical supplies are tabulated that are agreeable from the aspects of dose of exposure, precision, and shortening of diagnostic time compared with the pre-existing radioactive medical supplies. As in vitro radioactive medical supplies, many radioimmunoassay products, such as Australia-antigen kit and α-fetoprotein kit, are commercially available in accordance with the development of radioimmunoassay. (Ja)

4941 DICHLORO-DERIVATIVES OF NN'-ETHYLENEBIS (SALICYLIDENEIMINATO)URANIUM(IV) AND A REDISTRIBUTION REACTION FOR A URANIUM(IV) CHELATE. Calderazzo, F.; Pasquali, M.; Corsi, N. (Univ., Pisa, Italy). J. Chem. Soc., Chem. Commun.; No. 20, 784-785(24 Oct 1973).

A ligand redistribution reaction in tetrahydrofuran between $Usalen_2$ and UCl_4 led to the formation of $UsalenCl_2$, 2THF, which was also prepared by an independent method. (auth)

4942 APPARATUS FOR MEASURING SPECIFIC HEATS BETWEEN 1.5 AND 310°K. Danan, J.; de Novion, C. H. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 29-32(Apr 1973). (In French).

An apparatus is described which uses an adiabatic method to measure specific heats between 1.5 and 310°K and which takes into account temperature drifts occurring both before and after heating. The apparatus can be used to study plutonium compounds. The principal results obtained for actinide compounds are briefly reviewed. (Fr)

4943 MINIATURIZED M.C.B. TYPE CALORIMETER. Barberi, P.; Paillet, A. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 17-28(Apr 1973). (In French).

A newcomer on the market, the M. C. B. type microcalorimeter is compact, robust and possesses an exceptionally high sensitivity (50 to 60 μV/mW dissipated). It was possible with this apparatus to study the endothermal reduction of FeF_3 with iron (ΔH = 19 kcal/mole FeF_3) between 30 and 650°C using temperature programming (up to 200°C; hour). The microcalorimeter was connected to a McBain thermobalance in order to study the complexing of NaF by UF_6 at different temperatures. The microcalorimeter was provided with an air-tight vessel for measurements of the heats of transition and fusion of ClF_3 at low temperatures: ΔHf = 1780 cal/mole at −75.5, and ΔH_v = 357 cal/mole at 80.2°C. (Fr)

4944 CHEMICAL DIFFERENCES BETWEEN RARE EARTH AND TRANSURANIC ELEMENTS. Joergensen, C. K. (Univ., Geneva). J. Chim. Phys.; 70: No. 6, 1013-1015(Jun 1973). (In French).

It is shown that only indirect relations exist between the configuration of neutral atoms and the chemistry of elements, and that it is necessary to make a distinction between the chemical version and the spectroscopic version of the periodic table. (Fr)

4945 CHEMISTRY OF URANYL CARBONATES. I. The System Rutherfordite-Sharpite-Schoepite. Cejka, J.; Urbanec, Z. (Nationalmuseum/-Naturwissenschaftliches Museum, Prague). Collect. Czech. Chem. Commun.; 38: No. 8, 2327-2346(Aug 1973). (In German).

The system $UO_3-CO_2-H_2O$ was studied under both normal and hydrothermal conditions. Four phases are described: A (α-UO_3: $2H_2O$), B (UO_3 : 0.80 CO_2 : 1.06 H_2O), C (UO_2CO_3 : $2.2H_2O$) and HT $(UO_2(CO_3)_{1-x}(OH)_{2x}$, $(X \geq 0)$. The four phases were identified by the methods of chemical, thermal, and x-ray analysis as well as by infrared spectroscopy. The produced phases are discussed with respect to the system of secondary uranium minerals rutherfordite-sharpite-schoepite. (tr-auth)

4946 THERMOCHEMISTRY OF URANIUM COMPOUNDS. II. Standard Enthalpy of Formation of α-Sodium Uranate (α-Na_2UO_4). O'Hare, P. A. G.; Hoekstra, H. R. (Argonne National Lab., IL). J. Chem. Thermodyn.; 5: No. 6, 769-775(Nov 1973).

The enthalpy of reaction of α-sodium uranate (Na_2UO_4) with approximately 0.1 M HCl has been determined to be −(41935 ± 176)cal_{th} mol^{-1}. Combination of this result with measured enthalpies of solution of NaCl in HCl(aq) and of UO_2Cl_2 in an aqueous mixture of NaCl and HCl, together with auxiliary data from the literature, yielded ΔH_f°(α-Na_2UO_4, c, 298.15K) = −(445.5$_8$ ± 0.8$_5$) $kcal_{th}$ mol^{-1}. (auth)

4947 TRITIUM LABELING OF 20-METHYLCHOLANTHRENE. Roemer, J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Kiessling, M.; Murawski, D. Isotopenpraxis,: 9: No. 5, 174-175(May 1973). (In German).

Through a modified Wilzbach procedure, 20-methylcholanthrene was labeled with tritium. Electrical discharges were used as an external energy source. In comparison with the original Wilzbach procedure, the new method yielded products of a much higher specific activity. The products were analyzed by spectrophotometry, thin layer chromatography, and radiochromatography. The labeled 20-methyl-cholanthrene was very stable. The material could be stored as a benzene solution at room temperature; the yellowish coloration became somewhat more intense during storage. (HBG)

4948 $(C_6H_5)_4P[UOCl_5]$: A NEW TYPE OF URANIUM(VI) OXOCHLORO-COMPLEX. Bagnall, K. W.; du Preez, J. G. H. (Univ. of Manchester, Eng.). J. Chem. Soc., Chem. Commun.; No. 21, 820-821(7 Nov 1973).

The tetraphenylphosphonium salt, Ph_4P $[UOCl_5]$ has been obtained by reaction of $SOCl_2$ either with hydrated UO_2Cl_2 in the presence of Ph_4PCl or with $[Ph_4P]_2[UO_2Cl_4]$. (auth)

4949 DISPERSAL OF RADIOACTIVE MATTER BY EVAPORATION. Cardozo, R. L. Health Phys.; 25: No. 6, 593-598 (Dec 1973).

The evaporation velocity is calculated of radioactive substances that do not have a negligible vapor pressure under normal conditions of temperature and pressure. It is deduced that the maximum permissible concentration in air is readily attained for many compounds. A classification according to dangerousness is given based on an evaporation time which can be calculated for any compound under given conditions. (auth)

4950 INTERPRETATION OF THE VAPOR SPECTRUM OF UCl_4. Gruber, J.B. (Department of Physics, Washington State University, Pullman, Washington 99163); Hecht, H.G. J. Chem. Phys. 59: No. 4, 1713-1720 (15 Aug 1973).

Optical spectra of vaporized UCl_4 have been re-examined using refined spectroscopic techniques. Improved resolution and extension of the spectral range to include the near and far infrared have allowed us to make assignments on the basis of a tetrahedral crystal field model. Calculations based upon simultaneous diagonalization of electrostatic, spin-orbit coupling, and crystal field effects yield an excellent account of the observed spectral features, including a number of "hot bands," in terms of the following parameters: F_2 = 159.1 ± 1.5; F_4 = 45.76 ± 0.77; F_6 = 2.31 ± 0.08; ζ = 1756 ± 9; $A_4\langle r^4\rangle$ = − 817.4 ± 15.5; $A_6\langle r^6\rangle$ = − 71.20 ± 5.52; ν_3 = 330 ± 20; ν_4 = 110 ± 15 (all units in cm^{-1}). The magnitude of these parameters is discussed in terms of those reported by other workers. (auth)

4951 METHOD AND DEVICE FOR THE NONDESTRUCTIVE ANALYSIS OF NUCLEAR FUELS. Michaelis, W. (to Gesellschaft fuer Kernforschung mbH). US Patent 3,767,919. 23 Oct 1973. Priority date 31 Oct 1969, F.R. Germany. 4p.

A method and a device for the nondestructive analysis of nuclear fuels is described. The method provides that a neutron beam of a predetermined energy distribution is directed as the primary radiation at the nuclear fuel. The primary radiation penetrates the fuel completely and in this process, as a result of nuclear reactions, generates a secondary radiation in it. The secondary radiation emanates from all volume elements of the nuclear fuel element and reaches at least a space immediately surrounding it. The secondary radiation is there measured. The device contains a neutron source and a moderator disk providing a "1/E" neutron slowing down spectrum. (auth)

4952 CRYSTAL STRUCTURE OF β-TETRAKIS(ACETYLACETONATO)-NEPTUNIUM(IV). Allard, B. (Univ., Goteborg). Acta Chem. Scand.; 26: No. 9, 3492-3504(1973).

The crystal structure of β-tetrakis(acetylacetonato)neptunium (IV), molecular formula $[Np(C_5H_7O_2)_4]$, has been determined by x-ray methods. The unit cell is monoclinic (space group C2/c) with the lattice parameters a = 22.055 Å, b = 8.380 Å, c = 14.416 Å, β = 116.23°, V = 2390 $Å^3$ and Z = 4. The structure has been solved from three-dimensional Patterson and electron density calculations. A least squares refinement of the structure, based on 1844 independent structure factors, gave a final R-value of 0.090. The neptunium atom is coordinated by eight oxygen atoms in the form of a slightly distorted square antiprism (D_{4d}-$\bar{8}2m$), the mean value of the Np−O bond distances being 2.31 Å. The symmetry of the acetylacetonate ligand attachment around the antiprismatic inner coordination polyhedron is nearly D_2-222. The acetylacetonate ligand rings are not planar. The mean angle between the two planes O−Np−O and O−C−CH−C−O is 22.0°. (auth)

4953 CHEMISTRY OF KRYPTON, XENON, AND RADON. Bartlett, N. (Univ. of California, Berkeley); Sladky, F. O. pp 213-330 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on the chemistry of krypton, xenon, and radon that includes history; relationship of noble-gas compounds; bonding in noble gas compounds; adsorption, enclathration and encapsulation of noble gases; gaseous noble gas cationic and excited atom species; krypton chemistry; krypton compounds; xenon chemistry; and xenon compounds; radon chemistry; and radon compounds. (292 references) (DHM)

4954 SODIUM, POTASSIUM, RUBIDIUM, CESIUM, AND FRANCIUM. Whaley, T. P. pp 369-529 of Comprehensive In-

organic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on sodium, potassium, rubidium, cesium, and francium that includes discovery and history, occurrence and distribution, production and industrial uses, nuclear properties, chemistry and chemical properties, biological activity, and analytical chemistry. (366 references) (DHM)

4955 MAGNESIUM, CALCIUM, STRONTIUM, BARIUM, AND RADIUM. Goodenough, R. D.; Stenger, V. A. (Dow Chemical Co., Midland, MI). pp 591-664 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on magnesium, calcium, strontium, barium, and radium that considers discovery and history, occurrence and distribution, isolation and industrial uses, laboratory preparation, crystal structures and allotropic forms, physical properties, nuclear properties, chemical properties, biological effects, and analytical chemistry. Consideration is also given to the chemistry of alkaline earth metal alloys, compounds, and complexes. (153 references) (DHM)

Radioactive Waste Treatment

Refer also to abstracts 4859, 5006, 5611, and 5624.

4956 (BNWL-1772) TRANSMUTATION OF HIGH-LEVEL RADIOACTIVE WASTE WITH A CONTROLLED THERMONUCLEAR REACTOR. Wolkenhauer, W. C.; Leonard, B. R. Jr.; Gore, B. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 175p. Dep. NTIS $7.60.

Calculations were performed to predict the rate at which selected radionuclides in high-level waste undergo transmutation in the blanket region of a CTR. Idealistic conditions were assumed to facilitate the calculations. These conditions are expected to produce optimistic results and thereby define an apparent upper limit for the transmutation rates. An upper limit helps to define theoretical feasibility and determine incentives for further study. The waste constituents of the fission product category studied included; targets made of Sr and Cs, and the isotopes ^{90}Sr, ^{137}Cs, ^{85}Kr and ^{129}I. Isotopes between ^{232}U and ^{243}Cm were included in the actinide category. Calculations were made for neutrons obtained from both a D-D plasma and a D-T plasma to determine the effect of plasma type on the transmutation rate. Two neutron flux levels were also studied to determine the effect of neutron source strength on the transmutation rate. (auth)

4957 (CONF-720823-P2) PROCEEDINGS OF THE TWELFTH AEC AIR CLEANING CONFERENCE HELD AT OAK RIDGE, TENNESSEE, AUGUST 28-31, 1972. First, M. W. (ed.). (Harvard Univ., Boston, Mass. (USA). Harvard Air Cleaning Lab.; Oak Ridge National Lab., Tenn. (USA)). Jan 1973. 410p. Dep. NTIS $21.20 (2 volumes).

Separate abstracts were prepared for 16 of the 22 papers included in Volume II. The remaining papers appeared previously in NSA and can be located in the Report Number Index at CONF-720823. (DHM)

For abstracts of individual papers see: 4958-4961, 4978, 5005-5007, 5394, 5622-5626, 7056, and 7057.

4958 (CONF-720823-P2, pp 540-550) INORGANIC ADSORBER MATERIAL FOR OFF-GAS CLEANING IN FUEL REPROCESSING PLANTS. Wilhelm, J. G.; Schuettelkopf, H. (Kernforschungszentrum, Karlsruhe, Ger.). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In Proceedings of the twelfth AEC air cleaning conference.

An inorganic iodine adsorber material on the basis of $AgNO_3$-impregnated, amorphous silicic acid was developed for use in off-gas cleaning systems of fuel reprocessing plants. Extensive experimental work was performed to evaluate the removal efficiency of this material from off-gas containing NO_2 for elemental iodine and methyl iodide. Experimental data are given on the influence exerted by relative humidity, temperature, amount of NO_2 in the off-gas, granule size of the adsorber material, and iodine loading, on the performance of the inorganic iodine adsorber material. Also some data will be given on this material concerning the iodine loading capacity and desorption behavior of iodine at high temperature. The extent and consequences of isotopic exchange between iodine in the form of AgI on the surface of the inorganic adsorber material and iodine in the gas phase will be briefly discussed with respect to the performance time of the adsorber material; also the effects of radiation exposure are indicated. Moreover, data will be furnished on the removal efficiency of the inorganic adsorber material in the real off-gas of a fuel reprocessing plant; the operating conditions of full-sized iodine filters for fuel reprocessing plants and the price for off-gas cleaning with the inorganic adsorber material will be discussed. (auth)

4959 (CONF-720823-P2, pp 596-618) DEEP-BED FILTER PERFORMANCE TESTS. Schurr, G. A.; Zippler, D. B.; Guyton, D. C. (Du Pont de Nemours (E. I.) and Co., Aiken, SC). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Direct comparative tests of the filtration efficiency and particle holding capacity of sand and "Fiberglas" filters have been performed. Filters tested were modeled after designs currently in use at the Savannah River Plant and Hanford Works. The test program included: (1) efficiency determinations of sand and "Fiberglas" filters using DOP aerosol testing techniques, (2) comparative evaluation of the effectiveness of specific sand deposits, (3) the effect on efficiency and ΔP as a function of moisture in the sands under test, and (4) simulated high density smoke loading of both the sand and "Fiberglas" units. The tests have provided engineering data on filter performances and specific sand efficiencies. (auth)

4960 (CONF-720823-P2, pp 787-805) USE OF AIR CLEANING SYSTEMS AT NUCLEAR POWER STATIONS TO MEET LOWEST PRACTICABLE LIMITS. Thomasson, N. (Environmental Protection Agency, Washington, DC). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The principles of "low as practicable" are now being applied to radioactive effluents from commercial nuclear power reactors. The United States Atomic Energy Commission has proposed numerical guidance to what may be "low as practicable" in its proposed Appendix I to 10 CFR Part 50.36a. The proposed limitations on the discharge of ^{131}I are the most restrictive criteria. In order to evaluate the capability of a nuclear power plant to meet the proposed iodine concentration limits, input data (coolant fission product concentrations, leak rates, partition factors, and filter efficiency) must be available to obtain estimates of iodine discharges to the environment. Because of the lack of operational data regarding these parameters, it is necessary to make conservative assumptions. As a result, it is clear that, based on the conservative assumptions, light-water reactors will have problems in meeting not only Appendix I limits, as proposed, but, also, the presently applied limits when there are multiple reactors at a site and/or when there is poor atmosphere dispersion at a site. (auth)

4961 (CONF-720823-P2, pp 828-847) HIGH EFFICIENCY GASKETLESS ADSORBER. Barnebey, H. L. (Barnebey-Cheney Co., Columbus, OH). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A new type of adsorber was developed for the removal of ^{131}I, methyl iodide (^{131}I), and other radioactive species from air or gas mixtures that has the extended surface needed for large volume air flow, low resistance to flow, and completely without the use of gaskets. The elimination of gaskets does not, in this design, require special fabrication accuracy or the welding of leak-proof joints. The internal filter components are not built gastight. They are built charcoaltight, which requires less accuracy. Leaks from the upstream chamber to the downstream chamber are not avoided, but the design is made so that any leakage must be through a thickness of activated charcoal greater than the charcoal adsorber bed thickness. (DHM)

4962 (ORNL-TM-4366) PRESSURIZED AQUEOUS COMBUSTION OF ALPHA-CONTAMINATED WASTE. Final Program Status Report. Clark, W. E.; Ulrich, W. C. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 47p. Dep. NTIS $4.50.

Described is the status of the Pressurized Aqueous Combustion of Alpha-Contaminated Waste Program (formerly called the Plutonium Burning Program) at the time it was canceled on June 1, 1973. Results of laboratory investigations involving reaction studies, liquid and gaseous effluent cleanup problems, and corrosion research are summarized. The status of the process flowsheet design, the equipment design and procurement, and the construction of an engineering-scale experiment capable of treating 0.1 ton of combustible waste per day on a continuous basis is discussed, and some equipment cost data are presented. Recommendations for further laboratory work and pilot-plant development are also included. (auth)

4963 TRANSMUTATION OF HIGH-LEVEL RADIOACTIVE WASTES WITH A CONTROLLED THERMONUCLEAR REACTOR. Wolkenhauer, W. C.; Leonard, B. R. Jr.; Gore, B. F. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 52(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4964 TRANSMUTATION IN QUANTITY OF ^{137}Cs IN A CONTROLLED THERMONUCLEAR REACTOR. Gore, B. F.; Leonard, B. R. Jr. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 52-53(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4965 REMOVAL OF LOW-LEVEL RADIOIODINES FROM REACTOR OFF-GAS EFFLUENTS. Pence, D. T. (Allied Chemical Corp., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 62(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4966 SCRUBBING RADIOIODINE FROM REPROCESSING PLANT OFF-GASES WITH MERCURIC NITRATE SOLUTIONS. Crouse, D. J.; Schmitt, J. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17; 319-320(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4967 FLUID-BED INCINERATION OF RADIOACTIVE WASTES. Ziegler, D. L.; Johnson, A. J.; Meile, L. J. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 17: 330 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4968 INCINERATION OF LOW URANIUM CONTENT WASTES. Sakash, G.; Dawson, D. M. (General Electric Corp., Wilmington, NC). Trans. Amer. Nucl. Soc.; 17: 330-331(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4969 PRESSURIZED OXYGEN COMBUSTION. Bradley, N. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 331(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4970 CONDITIONING OF WASTES FOR POWER REACTORS. Sousselier, Y. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Trans. Amer. Nucl. Soc.; 17: 332(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4971 PROPOSED TRANSURANIC CONTAMINATED SOLID WASTE TREATMENT DEVELOPMENT FACILITY, LOS ALAMOS. Jordan, H. S. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 333(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radioisotope Production

Refer also to abstract 5320.

4972 (JINR-P12-7340) FAST GAS-THERMOCHROMATOGRAPHIC METHODS OF RADIOACTIVE ELEMENT EXTRACTION. IV. Extraction of Neutron-Deficient Zr and Nb Isotopes From the Silver Chloride Melt. Bayar, B.; Votsilka, I.; Zaitseva, N. G; Novgorodov, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From thermodynamic data silver chloride was chosen as target from which ultramicroquantities of neutron-deficient Zr and Nb isotopes were extracted. Further gas-thermochromatographic separation of these elements allowed radiochemically pure short-lived isotopes with the half-life up to 1.5 min to be obtained. (auth)

4973 RADIOPHARMACEUTICALS: CURRENT STATUS OF PRODUCTION AT BARC. Iya, V. K.; Mani, R. S.; Gopal, N. G. (Bhabha Atomic Research Centre, Bombay). pp 23-31 of Annual Conference of the Society of Nuclear Medicine. Mazumdar, S. K. (ed.). New Delhi; Organizing Committee for the Second Annual Conference of the Society of Nuclear Medicine (1970).

From annual conference of the Society of Nuclear Medicine; New Delhi, India (21 Oct 1970).

Current status of production of radiopharmaceuticals at the Bhabha Atomic Research Centre, Bombay is reviewed. Regular production of radioisotopes and labelled compounds for use in medicine began in 1963. At present 16 primary medical isotopes are produced by the activation of targets in the reactors APSARA and CIRUS. 33 labelled pharmaceuticals are produced by four methods, namely, (i) exchange reaction, (ii) trace labelling based on exchange or addition reaction, (iii) direct chemical synthesis and (iv) biosynthesis. The final product is always purified and when necessary sterilized. A very strict quality control at every stage starting from analysis of raw materials through various production processes, production facilities, packing and dispatch is maintained. Individual batches are subjected to physical, chemical and biological controls. The procedures in this connection are described. Problems faced in the production of radiopharmaceuticals in India are (i) indigenous nonavailability of the high purity special target chemicals, enriched isotopes and biochemicals which have to be imported at a high cost, (ii) irregular demand of radiopharmaceuticals in Indian medical institutions which does not allow to take up production of radiopharmaceuticals on a routine basis, (iii) limited number of irradiation facilities available for production and (iv) nonavailability of suitable carrier aircrafts for short-lived isotopes. Future programmes include expansion of production facilities for radiopharmaceuticals and production of short-lived medical radioisotope generator kits for ^{113}In and ^{99m}Tc. Two tables at the end give the product information in a detailed manner. (INIS)

4974 RADIOPHARMACEUTICAL GENERATOR KIT. Barak, M.; Winchell, H. S. (to Medi-Physics, Inc.). US Patent 3,749,556. 31 Jul 1973. Filed date 19 Aug 1971. 6p.

A kit readily assembled into essentially a packed chromatographic column for generating technetium-99m labeled pharmaceuticals in a simple two-step process is described. Technetium-99m pertechnetate in a first step is isolated and its valence state reduced by adsorption upon a reducing agent. Then the reduced technetium-99m in a second step is eluted from the reducing agent by combination with an immediately labeled biological compound, the eluant pH is adjusted and buffered to physiological levels and benign cations are substituted for uncombined reducing agent and isotope ions. A new technetium-99m labeled radiopharmaceutical useful in liver imaging is produced by interaction with the column packing in one specific aspect of the procedure. (auth)

4975 SEPARATION, ENRICHMENT, AND PRODUCTION OF RADIOISOTOPES BY THE HOT-ATOM CHEMICAL METHOD. Yoshihara, K. (Tohoku Univ., Sendai). Jap. Anal.; 22: No. 1, 122-132(Jan 1972). (In Japanese).

Separation and enrichment of radioisotopes by the Szilard-Chalmers process were reviewed on a laboratory scale, and the application to the full-scale production of radioisotopes was reported. Various methods of separation are outlined: (1) precipitation or coprecipitation, (2) ion exchange, (3) solvent extraction method, (4) paper chromatography, (5) electrophoresis, (6) distillation or sublimation, (7) gas chromatography, (8) mass analysis, and (9) method utilizing recoil energy itself. Three methods for preparing high concentration radioisotopes and the factors affecting yield and enrichment factors were reported. Further reports with detailed description in the literature were noted. Production processes of ^{64}Cu, ^{51}Cr and ^{32}P and targets by Szilard-Chalmers method were described. In the production of ^{64}Cu, copper phthalocyanine is the target and the specific radioactivity of the prepared ^{64}Cu is over 1000 Ci/g with a neutron flux range of (4-6) $\times 10^{12}$ n/cm^2 sec. In the production of ^{51}Cr, potassium chromate is the target and the specific radioactivity of the prepared ^{51}Cr is 50-100 Ci/g and stable. (tr-auth)

Reactor Fuel Reprocessing

Refer also to abstract 4925.

4976 (CF-64-12-5) ROVER FUEL REPROCESSING DEVELOPMENT, JUNE 1, 1964-JULY 1, 1964. (Oak Ridge National Lab., Tenn. (USA)). 1964. Contract W-7405-eng-26. 60p. Dep. NTIS $5.00.

Declassified 24 Sep 1973.

The development of reactors for propulsion of space vehicles

is resulting in the accumulation of a large amount of enriched uranium (93% ^{235}U) in the form of graphite-matrix fuel elements used in the ground tests. The fuel is a dispersion of pyrolytic-carbon-coated particles of uranium carbide in a graphite matrix, which is penetrated by flow channels lined with niobium carbide. The pyrolytic-carbon coating of the fuel particles is impervious to customary aqueous dissolvents, and this led to combustion of the coating and the graphite matrix as the primary head-end treatment, leaving an oxide ash (U_3O_8 and Nb_2O_5) to be either fluorinated or handled by aqueous processes for recovering the uranium. Although the major development work was based on conventional combustion, a wet-oxidation method is also being studied. Two types of processes have been developed at Oak Ridge and Brookhaven National Laboratories in order to recover the uranium from the oxide mixture left after burning the fuel, which was oxidized in either fixed- or fluidized-bed burners. In one process (fluoride volatility), the uranium and niobium oxides are fluorinated to produce volatile fluorides, which are separated by a combination of condensation and sorption. The product is high-purity uranium hexafluoride. Fixed- or fluidized-bed fluorinators may be used. At Oak Ridge, fixed-bed combustion and fluorination were studied and then demonstrated "cold" on a pilot-plant scale (about 5 kg of uranium per batch), with better than 99% recovery of the uranium. The second process includes dissolution of the combustion ash in nitric–hydrofluoric acid, followed by solvent extraction recovery of the uranium. A variation of this process is called the digest-burn-dissolve process. Here, the niobium carbide liners are dissolved in nitric–hydrofluoric acid (digest portion of the process), and then the fuel element is burned. Finally, the uranium oxide is dissolved in nitric acid prior to purification by solvent extraction. The digestion phase of this process was also demonstrated at Oak Ridge in plant-prototype equipment, with uranium losses being 0.1%. (auth)

4977 (CF-65-6-13) CONCEPTUAL ENGINEERING DESIGN AND ECONOMIC EVALUATION OF THE BURN-ACID-LEACH AQUEOUS PROCESS AND OF THE BURN-FLUORIDE-VOLATILITY PROCESS FOR RECOVERING SPENT ROVER FUEL AT THE IDAHO CHEMICAL PROCESSING PLANT. Nicholson, E. L. (Oak Ridge National Lab., Tenn. (USA)). 8 Jun 1965. Contract W-7405-eng-26. 93p. Dep. NTIS $6.75.

Declassified 24 Sep 1973.

Two detailed, conceptual process, equipment, and plant designs were prepared for facilities for recovering spent Rover fuel (highly enriched uranium–graphite) at the Idaho Chemical Processing Plant. The results of the study indicate that the fluoride-volatility process is preferred on both economic and technical grounds. Both processes employ a common fuel shipping, storage, and charging system and use continuous, fluidized-bed oxidation of the fuel as the first step of the head-end operation. Subsequent operations in the aqueous process include batch leaching the ash with 5 *M* HF—10 *M* HNO_3 in two parallel lines of Teflon-lined leaching and feed-preparation equipment, followed by solvent extraction to decontaminate and recover the uranium as uranyl nitrate. Post-burning operations in the fluoride-volatility process include the continuous fluidized-bed and moving-bed fluorination of the ash followed by partial condensation to remove niobium pentafluoride and passage of the UF_6 through heated sodium fluoride pellets to completely decontaminate the uranium. The uranium is recovered as uranium hexafluoride. (auth)

4978 (CONF-720823-P2, pp 528-539) DETERMINATION OF THE RADIOACTIVE NUCLIDES PRESENT IN THE OFF-GAS STREAMS GENERATED BY THE HEAD-END STEPS IN REPROCESSING HTGR TYPE FUELS. Lowrie, R. S.; Fitzgerald, C. L.; Vaughen, V. C. A. (Oak Ridge National Lab., TN). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Results of studies to determine the behavior of radioactive nuclides in the gaseous waste streams generated during the reprocessing of spent High Temperature Gas-Cooled Reactor (HTGR) fuel are presented. The fuel is in the form of coated particles of uranium and thorium, bonded into fuel sticks, and inserted into holes in large hexagonal graphite blocks. Spent fuel is reprocessed to recover the bred ^{233}U and the unburned ^{235}U. Preliminary tests, primarily to measure ^{85}Kr and tritium release, were made using Dragon fuel compacts containing either BISO-coated $(U-Th)O_2$ sol-gel particles or both TRISO-coated ThC_2 and TRISO-coated UC_2 particles. Burning the BISO-coated $(U-Th)O_2$ particles released the bulk of the ^{85}Kr (97-98%) and the tritium (98-99%); the remainder was released during the leaching step. The initial burning of the mixed TRISO-coated ThC_2 and TRISO-coated UC_2 fuel released ~7.4% of the ^{85}Kr. Subsequent grind-burn steps released an additional 7.4% of the ^{85}Kr from the ThC_2 particles and 84.5% from the UC_2 particles. (DHM)

4979 (DOCKET-701432-1) WESTINGHOUSE RECYCLE FUELS PLANT. License Application, Volume 1. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). 12 Oct 1973. 487p. Dep. NTIS $26.50.

Data are presented to support an application for a license for a plutonium processing and fuel fabrication plant known as Westinghouse Recycle Fuels Plant located near Anderson, South Carolina. Volume I contains information concerning the introduction and general description of the plant and site characteristics. (DHM)

4980 (DOCKET-701432-2) WESTINGHOUSE RECYCLE FUELS PLANT. License Application, Volume 2. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). 12 Oct 1973. 498p. Dep. NTIS $27.00.

Data are presented to support an application for a license for a plutonium processing and fuel fabrication plant known as Westinghouse Recycle Fuels Plant located near Anderson, South Carolina. Volume II contains information concerning design of structures, components, equipment, and systems; facility description; and process description. (DHM)

4981 (DOCKET-701432-3) WESTINGHOUSE RECYCLE FUELS PLANT. License Application, Volume 3. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). 12 Oct 1973. 304p. Dep. NTIS $17.25.

Data are presented to support an application for a license for a plutonium processing and fuel fabrication plant known as Westinghouse Recycle Fuels Plant located near Anderson, South Carolina. Volume III contains information concerning engineered safety features; instrumentation and control; electrical power; and auxiliary systems. (DHM)

4982 (DOCKET-701432-4) WESTINGHOUSE RECYCLE FUELS PLANT. License Application, Volume 4. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). 12 Oct 1973. 438p. Dep. NTIS $24.00.

Data are presented to support an application for a license for a plutonium processing and fuel fabrication plant known as Westinghouse Recycle Fuels Plant located near Anderson, South Carolina. Volume IV contains information concerning radioactive waste management; radiological protection; conduct of operations; initial tests and operation; off-site effects of accidents; and proposed technical specifications. (DHM)

4983 (ICP-1035) ICPP SOLUBLE POISON METER. Georgeson, M. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Sep 1973. Contract AT(10-1)-1375. 28p. Dep. NTIS $4.00.

A study of the ICPP Soluble Poison Meter was conducted to determine the adequacy of the new digital design for determination of soluble nuclear poison concentrations at the Idaho Chemical Processing Plant. A large portion of the information determined during this study is presented in this report. The design is entirely adequate to meet the essential performance requirements. Suggestions are given for further improving and updating the system to maximize the accuracy and increase reliability for use in present and future applications. (auth)

4984 (ORNL-2640) TENTATIVE GRIND–LEACH PROCESS FOR ROVER FUELS. Fitch, A. Jr.; Ferris, L. M. (Oak Ridge National Lab., Tenn. (USA)). 13 Jan 1959. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Declassified 24 Sep 1973.

A tentative flowsheet is presented for the recovery of uranium from prototype Rover fuel by leaching with boiling 15.8 M HNO_3. The effects of uranium content of the fuel, nitric acid concentration, and particle size on the efficiency of leaching were partially determined. For fuel containing more than 100 mg U per cc (5 wt %), 99.3% of the uranium was leached in 6 hr with 8 M HNO_3 when the fuel was ground to -16 mesh. However, only 98.6% of the uranium was leached from fuel containing 35 mg U per cc (1.8 wt %) in 6 hr with 15.8 M HNO_3 when the fuel was ground to -16 mesh. The use of 8 M HNO_3 on fuel of the latter composition resulted in even lower uranium recoveries. (auth)

4985 (ORNL-3196) URANIUM RECOVERY FROM KIWI FUEL ELEMENTS: LABORATORY DEVELOPMENT. Ferris, L. M.; Kambach, L. A. (Oak Ridge National Lab., Tenn. (USA)). 18 Dec 1961. Contract W-7405-eng-26. 26p. Dep. NTIS $3.50.

Declassified 29 Aug 1973.

Potential methods for recovering uranium from the graphite-base KIWI reactor fuel elements are being developed at ORNL on a laboratory scale. Three techniques that are being evaluated are:

(1) a 90% HNO_3 process, in which the elements are simultaneously disintegrated and leached with 21 M HNO_3; (2) a combustion-dissolution process in which the elements are burned in oxygen prior to dissolution of the oxide residue in nitric acid; and (3) a grind-leach process in which the fuels are mechanically ground to a fine powder before being leached with 15.8 M (70%) HNO_3. Uranium recovery from KIWI-A fuel (a homogeneous dispersion of UC_2 in graphite) is nearly quantitative by either the 90% HNO_3 or combustion-dissolution process. After two 4-hr leaches of irradiated KIWI-A fuel (0.001% burnup) with boiling 90% HNO_3, the uranium loss to the graphite residue was generally less than 0.5%; about 50% of the long-lived fission products also remained with the residue. The oxide combustion residue could be dissolved completely in boiling 7.5 M HNO_3–0.75 M HCl. Hydrochloric acid was a necessary component of the dissolvent because of the iron impurity in the fuel. During the combustion, up to 95% of the ^{106}Ru was volatilized. Uranium can be recovered from NbC-coated KIWI fuels by a modified 90% HNO_3 process in which the NbC is dissolved in HNO_3-HF solution. (auth)

4986 (ORNL-3283) URANIUM RECOVERY FROM KIWI-B FUEL ELEMENTS: LABORATORY DEVELOPMENT. Part II. Ferris, L. M.; Kibbey, A. H.; Warren, K. S. (Oak Ridge National Lab., Tenn. (USA)). 3 Dec 1962. Contract W-7405-eng-26. 42p. Dep. NTIS $4.25.

Declassified 24 Sep 1973.

Laboratory-scale studies were made on aqueous dissolution methods for recovering uranium from NbC-lined KIWI B (graphite-base, uncoated particles) fuel elements. Burning the fuel in oxygen and dissolving the ash completely in 1 to 21 M HNO_3 containing 1 to 5 M HF recovered the uranium quantitatively; complete dissolution required less than 5 hr when the F/Nb mole ratio was ≥60. Mechanical grinding of fuel followed by a 6-hr leach with boiling 4 to 10 M HNO_3 containing 0.3 to 2M HF resulted in uranium losses that decreased from 5 to 0.4% as the F/Nb mole ratio increased from 0 to 100 with -8 mesh fuel; the losses were half of those above when -50 mesh fuel was used. With two HNO_3-HF leaches and with a HNO_3 leach followed by a HNO_3-HF leach, losses were less than 0.1% with an overall F/Nb mole ratio of less than 6. Simultaneous disintegration and leaching with boiling 90 to 95% HNO_3 containing 0.5 to 2M HF for 6 hr resulted in uranium losses that decreased from 3 to 0.4% as the F/Nb mole ratio increased from 0 to 35 and were only 0.05% with multiple leaching and a F/Nb mole ratio of less than 6. (auth)

4987 (ORNL-3376) LABORATORY DEVELOPMENT OF CHLORIDE VOLATILITY PROCESSES FOR THE RECOVERY OF URANIUM DIRECTLY FROM SPENT ROVER FUEL OR FROM ITS COMBUSTION ASH. Gens, T. A. (Oak Ridge National Lab., Tenn. (USA)). 4 Jun 1963. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

Declassified 24 Sep 1973.

Two chloride volatility processes for the recovery of uranium from the combustion ash from spent Rover fuel were studied in the laboratory. The fuel consists of graphite impregnated with uranium carbide. The cooling channels are of niobium carbide. In each method, the uranium is isolated as UCl_4 and it may be further processed by aqueous solvent extraction (Darex) or fluoride volatility methods. The combustion–chlorination process involves burning the fuel elements in oxygen at 700 to 900°C and then chlorinating the uranium and niobium oxide products with 15 vol % CCl_4–85 vol % Cl_2 at 500°C. The volatilized uranium and niobium chlorides are collected at room temperature and then separated by selective volatilization of niobium chloride by controlled heating to 400°C. Uranium recovery is quantitative, and less than 1% of the niobium remains with the uranium. Corrosion rates for nickel or high-nickel alloys are expected to average about 0.5 mil/month through the cycle. The combustion-chlorination process should be reducible to large-scale practice because the reactions proceed readily, and the corrosion problems are minor. In the direct chlorination process, rough-crushed Rover fuel is treated with chlorinating and mixed chlorinating–oxidizing gases at 800°C. Uranium and niobium chlorides volatilize and are separated as in the combustion–chlorination process. Uranium recoveries are greater than 99%. About 40% of the graphite burns. Corrosion rates are excessive, more than 1 in./month for metal containers. Consequently, direct chlorination is not presently reducible to large-scale practice. (auth)

4988 (ORNL-3434) RECOVERY OF URANIUM FROM GRAPHITE FUELS BY OXIDATION AND FLUORINATION. Part I. Design and Initial Operation of Engineering-Scale Apparatus for Rover Fuel. McNeese, L. E.; Scott, C. D. (Oak Ridge National Lab., Tenn. (USA)). 6 Oct 1963. Contract W-7405-eng-26. 49p. Dep. NTIS $4.50.

Declassified 24 Sep 1973.

The recovery of uranium from graphite–uranium carbide fuels, such as the Kiwi type used in the Rover project, by oxidation with oxygen or air and subsequent direct fluorination of the ash by elemental fluorine is being investigated on an engineering scale. Accordingly, a small, engineering-scale, experimental facility was designed, built, and operated. The first six tests, made with a $2^1/_2$-in.-diam reactor containing 5 to 7 prototype Kiwi-B-1B-type fuel rods up to 18 in. in length, indicated process feasibility on this scale for oxidation by air or oxygen and fluorination by elemental fluorine. Uranium recovery from the fuel of more than 99.9% was demonstrated, and the reaction temperature and the carbon monoxide content of the reactor effluent were kept within safe limits. The oxidation ash remained in place in the reaction vessel, thus making it possible to perform this two-step process in one vessel. Oxygen utilization up to 45% and fluorine utilization up to 60% were demonstrated. Separation of the volatile uranium fluoride product from other volatile fluorides was also demonstrated. (auth)

4989 (ORNL-3435) LABORATORY DEVELOPMENT OF A PROCESS FOR RECOVERING URANIUM FROM ROVER FUEL BY COMBUSTION, LIQUID-PHASE CHLORINATION WITH HEXACHLOROPROPENE, AND AQUEOUS EXTRACTION. Gens, T. A.; Borne, T. B. (Oak Ridge National Lab., Tenn. (USA)). 28 Jun 1963. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

Declassified 24 Sep 1973.

The purpose of this work was to develop a process for recovering the uranium from spent Rover fuels. Only one reactor is used, and the process involves a 4-hr combustion of the fuel in oxygen at about 800°C, a 4-hr chlorination of the U_3O_8-Nb_2O_5 ash in refluxing hexachloropropene at 180°C, dissolution-extraction of the UCl_4 and $NbCl_5$ products at room temperature by dilute nitric acid, and extraction of the uranium from the resulting acid solution with 30% TBP in Amsco diluent. The results indicate that an extract containing 50 g of uranium per liter can be produced in seven or eight extraction stages, with total uranium losses of less than 0.02%. Corrosion rates of several possible construction materials during chlorination are less than 0.1 mil/month. Problems in the process involve handling about 10% of the niobium as a solid during the liquid-liquid separations, and handling solutions containing chloride. The results of this laboratory-scale work indicate that the liquid-phase chlorination and subsequent extraction operations are reducible to large-scale practice, since these operations resemble the liquid-phase operations typically performed in radiochemical separation plants. (auth)

4990 (ORNL-3459) AQUEOUS PROCESSES FOR URANIUM RECOVERY FROM ROVER FUEL ELEMENTS: LABORATORY DEVELOPMENT. Part III. Summary of the Processes. Ferris, L. M.; Warren, K. S. (Oak Ridge National Lab., Tenn. (USA)). 23 Dec 1963. Contract W-7405-eng-26. 45p. Dep. NTIS $4.25.

Declassified 24 Sep 1973.

The development of aqueous methods for processing Rover fuel elements is summarized. The Rover fuel elements are dispersions of carbon-coated UC_2 particles in graphite matrices; hydrogen coolant channels in the elements are lined with NbC to retard corrosion. Since the coated particles are impervious to attack by aqueous reagents, burning of the fuel is necessary at one stage of the process. The two main processes under development are (1) the Deline-Burn-Dissolve (DBD) process, and (2) the Burn-Dissolve process. Both processes result in almost quantitative uranium recovery; however, based on the laboratory experiments, the DBD process appears to have the best chance of success on an engineering scale. (auth)

4991 (ORNL-TM-696) COMBUSTION–DISSOLUTION EXPERIMENTS WITH IRRADIATED ROVER (KIWI-B4A) FUEL. Ferris, L. M.; Warren, K. S. (Oak Ridge National Lab., Tenn. (USA)). 4 Oct 1963. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Declassified 29 Oct 1973.

Fuel element specimens from the Kiwi-B4A reactor, which were lined with NbC but which did not contain coated fuel particles, were burned for 6 hr in oxygen at ambient temperatures ranging from 700 to 1400°C to determine fission product volatility and dissolubility of the U_3O_8-Nb_2O_5 ash in HF-HNO_3 solution. Uranium, niobium, zirconium, cerium, and strontium were virtually nonvolatile during combustion. Ruthenium and cesium were volatilized to a considerable extent, especially at 1200 and 1400°C. The amount of ruthenium volatilized increased from 35% to nearly 100% as the ambient temperature increased from 700 to 1400°C. Little cesium volatility was noted at 700°C, but, at 1400°C, as much as 40% volatilized. Essentially none of the volatile activity passed through a 40-μ porosity nickel filter maintained either at room temperature or at 200°C. In each experi-

ment, the U_3O_8-Nb_2O_5 ash was very friable and dissolved completely in 7 hr in boiling 5 M HF–5 M HNO_3 (F/Nb mole ratios of 70 to 80). The results of these experiments indicate that a Burn-Dissolve process for Rover fuels is chemically feasible if the combustion temperature is controlled to 1400°C or lower. (auth)

4992 UNIVERSAL SOLVENT EXTRACTION–TITRATION METHOD FOR THE RAPID AND ACCURATE DETERMINATION OF URANIUM IN COMPLEX SOLUTIONS. Walker, C. R.; Vita, O. A. (Goodyear Atomic Corp., Piketon, OH). Anal. Chim. Acta; 67: 119-127(1973).

A rapid and accurate method was developed for the determination of uranium in complex solutions produced in the recovery of uranium from nuclear fuels. These solutions usually contain 0.1–20 g U l^{-1} and high concentrations of aluminum nitrate in addition to a variety of cations and anions associated with fuel-element constituents and dissolution media. The method involves the solvent extraction of uranium from an acid-deficient aluminum nitrate–tetrapropylammonium nitrate solution into 2% tributyl phosphate in n-amyl acetate. The uranium is then backextracted with a concentrated phosphoric acid solution, and titrated by the method of Davies and Gray. The uranium extraction efficiency for sample solutions weighing up to 50 g is 99.9% or better, and the limit of error per analysis with 95% confidence is ±0.6%. No prior sample preparation is necessary, no expensive equipment is required, and even unskilled personnel can do duplicate analyses in 1.5 h. (auth)

4993 DYNAMICS AND CONTROL OF URANIUM PRODUCT EVAPORATOR. Katoh, N.; Kiyose, R.; Yamamoto, Y. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 501-506(Aug 1973).

It was established that the dynamics of an evaporator show markedly asymmetric responses. These phenomena are closely related to the response of the liquid level which directly affects the heat capacity. What is more, the time constant of an evaporator are so large that the transfer functions expressing uranium product evaporator are better approximated by a form representing no self-regulation. Examination of the controllability aspects of three different control algorithms, i.e., control by boiling point raising, cascade control and multivariable control, resulted in the conclusion that the last-mentioned algorithm is superior to the two others for controlling the uranium concentration which is the most important element in uranium product evaporation. (auth)

4994 SEPARATION OF URANIUM-233 BY DOUBLE DECOMPOSITION OF ThO_2 WITH SULFURIC ACID. Akatsu, J. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 448-450(Jul 1973).

A method for separating ^{233}U from irradiated thorium dioxide is presented in which the thorium dioxide changes to thorium sulfate when heated in H_2SO_4 (H_2O_2) solution. The thorium sulfate is practically insoluble in this solution, while the ^{233}U leaches out into the solution as U(VI). (DHM)

4995 REMOVAL OF VOLATILE TELLURIUM FLUORIDE IN LOW CONCENTRATIONS BY ACTIVATED ALUMINA. Komaki, Y.; Iwasaki, M.; Tsujimura, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 385-387 (Jun 1973).

The adsorption efficiency of alumina columns for low concentrations of TeF_6 and its dependence on carrier-gas velocity was studied. It was found that removal efficiency of the alumina columns decreases abruptly above a certain velocity of the carrier gas. It is concluded that activated alumina can be effectively used regardless of the concentration of Te if conditions are properly controlled. (JGB)

4996 DESCRIPTION OF A PROCESS FOR RECOVERING URANIUM FROM GRAPHITE-BASED ROVER FUEL. Hogg, G. W. (Allied Chemical Corp., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 318(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4997 REDUCTION IN CAPITAL COSTS OF FUEL REPROCESSING PLANTS. Costello, J. M.; Levins, D. M. (Australian Atomic Energy Commission, Coogee, New South Wales). Trans. Amer. Nucl. Soc.; 17: 320(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

4998 OPTIMIZATION OF ON-LINE ALPHA MONITORS. Gozani, T.; Crosbie, K. (Intelcom Rad Tech., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 322-323(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

ENGINEERING

Energy Conversion

Refer also to abstract 6123.

4999 (CEA-R-4488) ISOTOPIC CARDIAC PACEMAKER SAFETY TESTS AT 1300°C AND 800°C. Carrard, C.; Milet, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 42p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

In accordance with the safety guidelines which are specified by the Nuclear Energy Agency of the O.E.C.D. (Organization for Economic Cooperation and Development) the test program on the entire LAURENS ALCATEL MEDTRONIC type 9000 cardiac pacemaker has been continued with fire testing [800°C for 30 min] and cremation testing [1300°C for 30 min]. In addition to the previous tests, a simulated fuel was used in the source, and the testing was conducted under a pressure inside the inner tantalum capsule, corresponding to the pressure buildup after at least 10 y of operation. The first part of the report presents the reasons for the choice of natural uranium for the simulated fuel; in the second and third parts respectively, the results of the testing at 800 and 1300°C are described. In all cases, the tantalum capsules remained fully tight and no outward diffusion of radioactive material was observed. (auth)

5000 (N-73-21560) POSTOPERATIONAL EXAMINATION OF AN EXTERNALLY CONFIGURED THERMIONIC CONVERTER. Phillips, W. M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 15 Mar 1973. Contract NAS7-100. 19p. (NASA-CR-131523; JPL-TM-33-597). NTIS.

An externally configured thermionic converter was operated for 200 h. The converter was disassembled and examined to determine internal changes as a result of operation. The metal/ceramic seals and all joints were unaffected by operation. Converter output voltage and operational time were sufficient to produce electrolysis of stabilized zirconia spacers used in the converter. Surface analysis of the electrode surfaces indicated the presence on the tungsten emitter of only oxygen, carbon, and silicon. The niobium collector was, however, 25 to 40% covered with other elements. This coverage represented all elements present within the converter as construction materials other than silicon and tungsten, which were not detected on the collector, and carbon, which was detected only in small amounts. (auth)

5001 (WANL-PR(CC)-039) COMPACT THERMOELECTRIC CONVERTER. Quarterly Progress Report, July 1, 1968–September 30, 1968. Phase II-C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Astronuclear Lab.). 12 Oct 1968. Contract AT(29-2)-2638. 92p. Dep. NTIS $6.75.

Declassified 30 Aug 1973.

An initial analysis of experimental heatup data was compiled to determine the success of module experiments designed to triple the voltage power ratio of standard TEM-9 modules. Accomplishment of this design improvement is extremely significant in the development of tubular module systems having lower power applications. With the increased voltage to power ratio, power conditioning devices will not be required to step up the module output voltage to a more usable level. Heatup data from TEM-9AE S/N-1, employing 0.030-inch lead telluride washers and 0.0015-inch mica insulators, correlate very closely with performance calculations. A study was initiated to determine an optimum design for a module to be internally fueled using cobalt-60. In addition, alterations to the calculation model TEMOD were made to handle the effects of gamma heating within the lead telluride washers. An experimental test program was defined which would verify the validity of the mathematical model. Additional analytical work was accomplished to correlate predicted axial heat transport rates of heat pipes with experimental data. A study of sodium heat pipe performance data revealed that a sonic vapor velocity can occur in the region between evaporator and condensor sections of the heat pipe to produce a limit to the axial heat transfer rate. Evaluation of niobium contacts show them to be considerably more compatible with p-type lead telluride than iron contacts. However, the niobium does not yield absolute electrical stability and, as a result, no further work beyond the present analysis is contemplated. Six modules containing solid tungsten conductors were placed on test at elevated temperatures. Although degradation rates measured were the lowest yet recorded for modules employing TEGS-2P material, for temperatures above 1100°F the most stable operation is achieved through the substitution of TEGS-3P material for TEGS-2P material. (auth)

5002 VISCOUS FLOW OF AN INHOMOGENEOUS PLASMA IN A COAXIAL STRUCTURE WITH A THERMIONIC CATHODE. Nevolin, V.K. Sov. Phys.–Tech. Phys. 17: No. 12, 2014-2016 (June 1973).

The flow of a cesium plasma in a coaxial structure with a thermionic cathode is studied. Relationships are found which describe the viscous flow of the inhomogeneous plasma. The essential features of the current profile along the structure are established. A method of determining the coefficient of dynamic viscosity is suggested. (auth)

5003 ANALYSIS OF INTERNAL PRESSURE BEHAVIOR AS A FUNCTION OF VENT SIZE IN A RADIOISOTOPIC THERMOELECTRIC GENERATOR. Travis, J. R.; Peterson, D. E.; Mulford, R. N. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 12(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5004 RISK/BENEFIT ANALYSIS OF THE BETACEL NUCLEAR-POWERED PACEMAKER. Greenborg, J.; Smith, T. H.; Matheson, W. E. (Donald W. Douglas Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 100-101(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Facilities and Equipment

Refer also to abstracts 4979, 4980, 4981, 7428, 7458, 7460, 7465, 7479, and 7480.

5005 (CONF-720823-P2, pp 677-702) PERFORMANCE OF ABSOLUTE FILTERS AT TEMPERATURES FROM AMBIENT TO 1000°F. First, M. W. (Harvard School of Public Health, Boston). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Sodium chloride aerosols were used to test the penetration of filter papers and commercially fabricated absolute filters over the temperature range from 150° to 1000°F. Although filtration theory indicates that penetration should decrease at elevated temperatures, this effect was not observed in practice. In some cases, obvious structural failures were observed after high temperature exposure, but even filters which appeared to be undamaged after heat exposure may have suffered some internal degradation that accounted for the failure to show a decrease in penetration. The principal structural failure occurred to aluminum corregated separators which lost their stiffness above 800°F. As the softened separators sagged, they permitted the filter pack to part from the top seal. Initial results indicate that sodium chloride aerosols can be used to evaluate the efficiency of filters at elevated temperatures. (auth)

5006 (CONF-720823-P2, pp 718-730) HIGH CAPACITY DOP AEROSOL GENERATOR. Progress Report. Rolie, A. G.; Adley, F. E. (Hanford Environmental Health Foundation, Richland, WA). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The objective of this program was to develop a portable DOP aerosol generator that would produce sufficient aerosol at a constant rate for the period of time required to test high-capacity HEPA filter systems at rated flow. Such a generator would make it possible to measure the efficiency quickly and quantitatively. Also, with suitable access to the ventilation system, tests could be performed remotely, thus avoiding radiation exposure to personnel conducting the tests. An experimental model has been designed, built, and successfully used at Hanford since October, 1971, to test filter systems which have rated flows up to 125,000 cfm. Based on experience with the unit, filter systems with capacities up to 200,000 cfm can be tested. This report describes the experimental unit and discusses the future objectives. (auth)

5007 (CONF-720823-P2, pp 731-737) GOVERNMENT-INDUSTRY MEETING ON FILTERS, MEDIA, AND MEDIA TESTING. Anderson, W. L. (Naval Weapons Lab., Dahlgren, VA). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The growth of participation in successive AEC Air Cleaning Conferences and the subjects discussed by the committee concerned with high-efficiency filters are reviewed. These subjects included: filter media caliper; determination of percent combustion; contamination of glass fibers; test standards; irradiation tests on HEPA media; radiation deterioration tests; media deterioration through use; filter specifications; qualification products listings tests; smoke penetrometer correlation; and fluoride-resistant glass media. (LCL)

5008 ROTORS OF LARGE STEAM TURBINES. Hohn, A. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Brennst.-Waerme-Kraft; 25: No. 9, 339-347(1973). (In German).

Rotors for large steam turbines are manufactured either as solid rotors by welding together single disks (drum rotor) or by the shrink fitting of disks on a central shaft. The state of loading in the rotor depends on the design concept, which has an influence on the choice of material and the bursting speed. The various designs are discussed, based on a disk of equal width, and the results of stress calculations for practical examples are given, as well as the conclusions to be drawn therefrom. (GE)

5009 CONDUCTION PUMP MODULE FOR CORROSIVE LIQUIDS. Carbonnel, H. (to Groupement Atomique Alsacienne Atlantique). French Patent 2,131,087. 31 Mar 1971. 9p. (In French).

A demountable conduction pump for corrosive liquid metals is presented which can be immersed in such liquids and which is provided with an adjustable outlet pressure system. The principal magnetic circuit gives rise to an induction field in a layer of liquid through which a current induced by a secondary magnetic circuit flows. The body of the pump is made of a refractory material. The parts of the magnetic circuit supporting the coils are kept outside the bulk of refractory material and are protected by a sheath. The body of the pump is constructed from demountable elements traversed by the liquid metal duct. Bolt-tightened pieces hold the assembly rigid, the elements being separated by ceramic wool joints which ensure the leak tightness of the pump. (FR)

5010 IMMERSION PUMPS FOR CORROSIVE LIQUID METALS. Carbonnel, H. (to Groupement Atomique Alsacienne Atlantique). French Patent 2,131,046. 30 Mar 1971. 8p. (In French).

A small immersion pump for corrosive liquid metals is described. It operates by conduction and consists of at least an electrical circuit element and two electrodes, a liquid metal duct, and a magnetic circuit, the main body of the pump being protected by a casing. The body of the pump consists of a block of refractory material either of cylindrical or polyhedral molded elements constituting the pump which are thus maintained in a predetermined position and isolated from any undesirable contact with the corrosive liquid metal. (FR)

5011 DEVELOPMENT OF A LABORATORY SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Cannon, D. D.; Davis, F. C.; Bradley, R. A.; Sease, J. D. (Oak Ridge National Lab., TN). Conf. Remote Syst. Technol., Proc.; No. 21, 14-20(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

A laboratory model of a machine for fabrication of HTGR fuel rods has been developed at Oak Ridge National Laboratory to demonstrate the feasibility of the slug injection process for remote fabrication of fuel rods from recycled fuel. The design for the laboratory slug injection machine is based on the principles employed in automated assembly equipment, and conventional indexing and parts feeding equipment are used. The laboratory machine is completely automated, and it performs the major processing steps of particle dispensing, blending, loading, and fuel rod forming at a fabrication rate of approximately 4000 fuel rods per day. (auth)

5012 PRODUCTION SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Davis, F. C.; Cannon, D. D.; Sease, J. D.; Bradley, R. A. (Oak Ridge National Lab., TN). Conf. Remote Syst. Technol., Proc.; No. 21, 21-27(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

A conceptual design of a production-scale slug injection machine for fabrication of HTGR fuel rods has been developed at Oak Ridge National Laboratory. This production machine employs the slug injection process, which has been demonstrated on a laboratory fuel rod machine. The proposed production machine has a projected fabrication rate of 35,000 to 70,000 fuel rods per day and it is applicable in both contact processing systems for production of fuel rods from virgin fuel and remotely operated processing systems for production of fuel rods from recycled fuel. (auth)

5013 USE OF OPTICAL PROFILOMETER SYSTEM AT LASL. Lazarus, M. E. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; No. 21, 111-112(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

The operation and performance of the optical profilometer equipment used at LASL to measure the diameters of unirradiated and irradiated fuel elements are discussed. Magnetic tape recorded measurements are made at every 0.001 in. (0.025 mm) along the length of the fuel element. The data output is computerized and data are supplied to the experimenter as either: film plots; printouts of position, average diameter, and standard deviation; tape output of corrected data for further computer calculations; or calcomp graph paper plots. After 800 runs on reactor fuel elements the equipment has consistently given results better than ±0.0002 in. (.005 mm). (LCL)

5014 APPLICATION OF WALSH TRANSFORMS AND THE LINEAR DISCRIMINANT TECHNIQUE TO VIBRATION ANALYSIS. Lynch, R. T.; Reis, J. J. (Northrop Corp., Hawthorne, CA). Trans. Amer. Nucl. Soc.; 17: 375-376(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5015 TIME-DEPENDENT FORCE APPROXIMATION FOR ELASTIC-PLASTIC RESTRAINT DYNAMICS. Harper, B. E. (Bechtel Power Corp., San Francisco). Trans. Amer. Nucl. Soc.; 17: 393(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5016 PREDICTION OF SHOCK ENVIRONMENTS BY TRANSFER FUNCTION MEASUREMENT TECHNIQUES. Kao, G. (Wyle Labs., Huntsville, AL); Cantril, J.; Shipway, G.; Boyd, M. Trans. Amer. Nucl. Soc.; 17: 393-394(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5017 N45.2.5: CONSTRUCTION PHASE QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF STRUCTURAL CONCRETE. Schierberg, G. M. (Stone and Webster Engineering Corp., Boston). Trans. Amer. Nucl. Soc.; 17: 431-432(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5018 DEVELOPMENT OF A LABORATORY SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Cannon, D. D.; Davis, F. C.; Bradley, R. A.; Sease, J. D. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 508-509 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5019 PRODUCTION SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Davis, F. C.; Cannon, D. D.; Sease, J. D.; Bradley, R. A. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 509(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Heat Transfer and Fluid Flow

Refer also to abstracts 5012, 5236, 6315, 6865–6867, 6932–6934, 6944, 7005–7007, 7124, 7137, 7138, 7140–7142, 7194, 7348, 7453, and 7474.

5020 (CEA-CONF-2364) GEVATRAN: A COMPUTER PROGRAM TO STUDY TWO PHASE FLOW DYNAMICS. Boure, J. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1972. 14p. (CONF-720686-3). Dep. NTIS (U. S. Sales Only) $3.00.

From European two-phase flow group meeting; Rome, Italy (6 Jun 1972).

The development of a mathematical model for studying transients in two-phase flow is described. Simplified forms of the

momentum and energy equations were used. It was assumed that the flow is one-dimensional, the pressure is the same in both phases in a given cross section, and the physical properties of each phase are independent of pressure. Problems encountered in using the computer program, GEVATRAN, to numerically solve the equations developed are discussed. (LCL)

5021 (CEA-CONF-2366) PRESENTATION OF CURRENT STUDIES ON RELATED TOPICS. Boure, J. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1972. 18p. (CONF-720698-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on steam generators performance in P.W.R. plant; Turin, Italy (15 Jun 1972).

Two recent research studies on the classification of two-phase flow instability phenomena and on the GEVATRAN computer program for studying two-phase flow dynamics are discussed. (LCL)

5022 (RT/ING-(73)5) INITIAL SUPERHEATING IN THE BOILING OF LIQUID METALS IN FORCED CONVECTION: A POSSIBLE INTERPRETATION OF THE INFLUENCE OF VELOCITY. Scarano, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 May 1973. 23p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.25.

An analysis is presented of the studies and experiences on forced convection liquid-metal superheat. A new interpretation of velocity influence is also proposed. On the basis of this interpretation, a correlation, in agreement with the experimental data available in literature, was developed. (auth)

5023 PRESSURE FLUCTUATIONS IN A VAPOUR-LIQUID MIXTURE FLOW. Davis, M. R. (Univ. of New South Wales, Kensington, Australia). Int. J. Heat Mass Transfer; 16: No. 11, 2043-2054(Nov 1973).

Results of a series of measurements of unsteady wall pressure fluctuations for the upward flow of a vapor-liquid mixture of freon in a circular pipe are presented. They show the strong attenuation of incident pressure disturbances by the mixture, the generation of pressure fluctuations by the turbulent two-phase mixture flow, and the propagation of pressure disturbances associated with the flow in the direction of flow. The latter pressure disturbances appear to move at a velocity approximately 1.4 times that of the nominal average mixture velocity. (auth)

5024 AREA OF DEPARTURE FROM NUCLEATE BOILING IN ONCE-THROUGH STEAM GENERATOR. Strmiska, F.; Lochman, K. (Dept. of Nuclear Technology, Brno). Jad. Energ.; 19: No. 8, 253-256(Aug 1973). (In Czech).

The current state of heat transfer studies on direct steam generators, especially for heat transfer in the region of impaired heat exchange, is reviewed. Results of experimental studies are presented as well as calculations of the boiling crisis in steam-water flow. (tr-auth)

5025 BIOLOGICAL FLOW CALCULATIONS USING A POWERFUL NEW FINITE DIFFERENCE TECHNIQUE. Daly, B. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 242(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5026 FLUID NETWORK ANALYSIS. Porsching, T. A. (Univ. of Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 242(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5027 NUMERICAL TECHNIQUES OF FLUID FLOW. Birkhoff, G. (Harvard Univ., Cambridge, MA). Trans. Amer. Nucl. Soc.; 17: 242(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5028 UNIFIED ANALYSIS OF HEAT TRANSFER TO FLUIDS IN ANNULI. Axford, R. A.; Silady, F. A. (Univ. of Illinois, Chicago). Trans. Amer. Nucl. Soc.; 17: 246-247(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5029 IMPLICIT CHARACTERISTIC METHOD FOR ONE-DIMENSIONAL FLUID FLOW. Spencer, A. C. (Westinghouse Electric Corp., Pittsburgh); Nakamura, S. Trans. Amer. Nucl. Soc.; 17: 247-249(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5030 CHARACTERISTICS OF UNSTEADY ONE-DIMENSIONAL TWO PHASE FLOW. Gidaspow, D. (Inst. of Gas Tech., Chicago); Lyczkowski, R. W.; Solbrig, C. W.; Hughes, E. D.; Mortenson, G. A. Trans. Amer. Nucl. Soc.; 17: 249-250(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5031 PERIPHERAL-FLOW VISUALIZATION STUDIES WITH A 91-ELEMENT BUNDLE. Lorenz, J. J.; Pedersen, D. R.; Pierce, R. D. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 416-417(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5032 AXIAL HEAT FLUX EFFECTS ON DNB IN FORCED CONVECTION. France, D. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 426-427(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5033 ONCE-THROUGH STEAM GENERATORS ON THE LINE. McDonald, B. N. (Babcock and Wilcox Co., Lynchburg, VA); Michaud, E. R.; Scearce, J. S. Trans. Amer. Nucl. Soc.; 17: 438-439(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Materials Testing

Refer also to abstracts 5527 and 7219.

5034 (BNWL-1789) HIGH POWER ULTRASONIC BOND STRENGTH EVALUATION. Becker, F. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1973. 23p. Dep. NTIS $4.00.

Bond strength of diffusion and adhesive bonds has long remained one of the unsolved problems facing the materials testing industry. Many techniques are available for the detection of unbonds but these tend to become inaccurate when the unbonded surfaces are in intimate contact. Weak bonds in almost all cases cannot be distinguished from bonds which approach base material strengths. One must usually resort to destructive testing of samples cut from production parts to obtain bond strength information. This is not the most satisfactory method from a cost and reliability standpoint. The accuracy of this data is also in some doubt since the cutting procedure itself may disturb the bond and the residual stress pattern of the part. The ultrasonic approach has the potential of eliminating many of the limitations of existing bond testing techniques. The system is based on the use of high power ultrasonic waves to stress the bond interface with an acoustic pressure sufficient to break bonds of below minimum allowable strengths. Acceptable production parts may be 100% inspected with no detrimental effects. The technique, equipment, and transducers developed for this test as well as tests which indicate the feasibility of the method are described. Suggestions for further development are also included. (auth)

5035 (CEA-CONF-2339) ACOUSTIC EMISSION. Chretien, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1973. 100p. (In French). (CONF-730564-1). Dep. NTIS (U. S. Sales Only) $7.00.

From meeting on special nondestructive testing techniques; Lyon, France (23 May 1973).

The mechanisms involved in the generation of stress waves are reviewed. Theoretical models are given for the events resulting in the generation of waves. The apparatus necessary to detect and exploit the modes of constraint is described. Some applications of the technique to nuclear structures and materials are given. (FR)

5036 (SLA-73-716) PRECISION MEASUREMENTS IN LARGE ASSEMBLIES USING HIGH ENERGY RADIOGRAPHY. Mottern, R. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

This report describes holding fixtures and methods employed in alignment of source, specimens, and films used in radiography.

In this instance, radiography is employed in monitoring dimensional changes that occur in weapon systems because of environmental tests. Results achieved are accurate to within a few thousandths of an inch. (auth)

5037 (T-743, pp 3.125-3.131) NEUTRONOGRAPHY AND MICRONEUTRONOGRAPHY AND THEIR APPLICATIONS. Rant, J.; Copic, M.; Dimic, V.; Ilic, R.; Sirca, F. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Facilities and techniques used in neutronography as well as in microneutronography are described. Applications of both methods performed at the Triga Mark II reactor in Yugoslavia are mentioned and included the examination of metal adhesives in combination with glass fibers and the microstructural analysis of different binary alloy systems containing Cd. (LCL)

5038 PROGRESS IN METROLOGY AT THE AEA SPRINGFIELDS LABORATORIES. Metrol. Insp.; 5: No. 5, 39-45(Oct 1973).

The metrology laboratories at the AEA Springfields Laboratories are engaged in the solution of measurement problems which have very much wider application than the development and testing of fuel elements for nuclear reactors which were its primary concern. The Springfields standards room is B.C.S. approved for linear measurement covering the calibration of slip gauges, rings, verniers and all general masters. In addition to normal equipment there are some items of standard room equipment which have been applied to special investigations which are of interest. Among those described is the examination of internal welds in the joining of two tubes of different diameter where an internal fillet weld and an external weld are used. Another type of problem frequently encountered in industry is the comparison of two patterns, of which one may be a master, in order to detect differences. Assessments of contour and surface flatness are requirements frequently encountered and rigs for this purpose have been developed for use in association with the Talysurf and Talymin equipment to enable long components to be measured. Another application of the Talysurf is the investigation of finishes in small bores and equipment for this purpose is also used. The problems associated with checking tubes, which may be of almost any design section, and may also vary along their length because of manufacturing discrepancies or handling, have created at Springfields an awareness of the need for data processing which has become one of the major preoccupations of the metrology laboratories. The advantages of feeding both normal and complex inspection data onto punched tape are emphasized. Systems are described which are typical of those being used for a wide variety of tubes and wrappers or any shapes required where mathematical analysis of analogue signals enables reference planes to be compiled. Internal and external tube rigs up to 8 in. diameter are in use and corrections can be made for center of rotation at different points along the tube length. Another measuring operation carried out on the combined radius and angle measuring equipment is that of circumferential and axial strain measurements in tubes. Finally the use of the information obtained is discussed. Priority has been given to data logging, information retrieval and the interface equipment for applying these to inspection situations. (UK)

5039 PROCEDURE AND APPARATUS FOR IN REACTOR INVESTIGATIONS OF MECHANICAL PROPERTIES OF MATERIALS. Miloserdin, Yu. V.; Baranov, V. M.; Rimashevskii, A. V.; Kakurin, V. N. At. Energ. (USSR); 35: No. 2, 101-104(Aug 1973). (In Russian).

The procedure and apparatus used for in-reactor determination of elastic constants, internal friction, and long-term hardness of materials are described. The procedure is based on the determination of parameters of ultrasonic resonance vibrations for specimens in the form of discs of 20-mm diameter and 3-mm thickness. The elastic constants are calculated from resonance frequencies, internal friction from width of resonance curve, and hardness from shift in resonance frequency initiated by Vickers-pyramid indentation. The measuring equipment includes ultrasonic waveguides in the form of thin rods for transmission of vibrations to and from the specimens. Electronic equipment is located in a personnel workroom. The apparatus used makes it possible to measure the above-mentioned parameters on specimens of structural and fuel materials at temperatures of self-heating (up to 600°C) with an accuracy sufficient to detect comparatively small variations of registered parameters. (auth)

5040 TESTING OF WELDED JOINTS IN PIPELINE CONSTRUCTION WITH EXTERNALLY CONTROLLED ISOTOPIC SLUGS. Sauerwein, K. (Isotopen Technik Dr. Sauerwein GmbH, Dusseldorf). Chem.-Ing.-Tech.; 45: No. 19, 1151-1155(1973). (In German).

Isotopic slugs controlled from outside the pipe have been developed for rapid and thorough radiographic testing of newly-built pipelines. They travel from weld to weld and produce a record of all circumferential welded joints on externally applied x-ray films. The most important types of self-propelled slugs are reviewed and the various possibilities of their propulsion, control, and mode of travel are discussed. A more detailed account is given of the Gammamat M 6 (for 6 to 18" pipe diam.) and M 18 (for 18 to 60" pipe diam.) testing slugs. These slugs permit the testing of more than 2 km of pipeline, recording more than 200 x-ray photographs per day with a 2- or 3-man team. (GE)

5041 APPLICATION OF ACOUSTIC EMISSION TECHNIQUES TO MATERIAL DIAGNOSTICS. Nakasa, H. (Central Research Inst. of Electric Power Industry, Tokyo). pp 461-478 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From Symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Solid materials undergoing deformation or fracture emit characteristic sonic energy known as acoustic emission (AE). The major parameters available for characterizing AE signals are amplitude, rate of emission, and frequency content or wave shape. These are affected remarkably by material properties and inherent defects, as well as by external conditions such as stress and temperature. Hence, various types of material diagnostics can be performed on the basis of the precise analysis of the AE characteristics. The following AE characteristics have been examined: (1) in tensile testing of various specimens of steel and other metals degraded by neutron-irradiation embrittlement or prestraining; and (2) in the process of crack extension due to fatigue cracking in model testing for primary piping components of a fast breeder reactor. These test results have demonstrated that the AE techniques using the above-mentioned system are very useful for material diagnostics such as inspection of integrity, monitoring of degradation and anticipation of fracture. (auth)

5042 CHARACTERISTICS OF ^{170}Tm FOR INDUSTRIAL RADIOGRAPHY. II. Furuta, J.; Hiraoka, E.; Tsujii, Y. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 99-103(1972).

The attenuation curves for steel, aluminum, and lead derived from the observation of gamma-ray spectra, the fault sensitivity curves for aluminum and the observation of source shape with a pin-hole camera are reported. The low energy gamma-rays from ^{170}Tm can be easily filtered by a thin sample. Therefore, ^{170}Tm can be used for the inspection of aluminum samples less than 10 or 20 mm in thickness and of steel samples less than 3 or 5 mm. The lead foil screen is undesirable to obtain better radiographs. (auth)

5043 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. VII. Copying Method. Becker, E.; Nens, U. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 5, 177-181(May 1973). (In German).

From an original x-ray film showing a wide variation of densities, copies were made with films of various characteristics. Through contrast harmonization, the copies significantly improved the information evaluation in dense parts of the original. The copying method preserved the original for documentation. Detail recognition was enhanced in black areas of the original. The method extended the testable thickness of steel by one exposure as follows: 1 mm to 3 mm for 100 kV; 12 mm to 30 mm for 300 kV; 20 mm to 55 mm for ^{192}Ir; and 35 mm to 85 mm for ^{60}Co. (HBG)

5044 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. IV. Attenuation. Becker, E.; Nens, U. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 4, 134-137(Apr 1973). (In German).

Increasing in 0.1 mm steps from 0.1 to 1.5 mm diameters, a series of steel wires was mounted on a steel plate of 30 mm thickness. From this test sample, films were obtained through exposure to gamma radiation. The developed films then were treated with various reducers. Farmer's reducer containing potassium ferrocyanide was superior to all others. Reduction of the film density improved detail recognition and extended the testable thickness of steel to 110 mm for ^{60}Co and to 70 mm for ^{192}Ir. (HBG)

5045 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. V. Color Film Method. Becker, E. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 4, 138-141(Apr 1973). (In German).

With 100 kV x-radiation, color radiography was performed on aluminum test samples, using various foil combinations and subsequent exposure to monochromatic light. Color differences

occurred only when the test object differed by more than 10% in thickness. This sensitivity was much too low for practical purposes. Black-white radiography yielded a sensitivity of 1%. In its present state of development, color radiography was too expensive, too insensitive, and did not enhance the information content of the films. (HBG)

5046 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. VI. Coloration. Becker, E. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 4, 142-143 (Apr 1973). (In German).

For testing of materials, the two-film method appears suitable at x-ray energies below 100 kV. One film is obtained in green color at low energy; the other is obtained in red at higher energy. The two films then are superimposed and evaluated. At energies above 100 kV, the method fails to yield sufficient color contrast. The transformation of black-white into color radiographs does not improve the information evaluation of films. (HBG)

5047 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. VIII. Electronic Copying Method. Becker, E. (Technische Hochschule, Madgeburg, Ger.). Isotopenpraxis; 9: No. 5, 181-182(May 1973). (In German).

Original x-ray films showing a wide variation of densities were copied with an electronic copying machine developed by Carl Zeiss, Jena. The machine harmonized the contrast through an electronic intensity control of the copying light beam. The experiments showed that high density areas of the original could not be equalized. In its present state of development, the equipment was not suitable for radiography in testing of materials. (HBG)

5048 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. IX. Equidensity Method. Becker, E. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 5, 182-184(May 1973). (In German).

The test object was a piece of cast steel varying in thickness and containing several defects. An original film was obtained through radiography. From this negative, a positive copy was prepared and superimposed on the original. Copies of the negative-positive combination yielded equidensity lines. Equidensity films also were prepared with the Sabattier effect. Neither the negative-positive method nor the Sabattier effect enhanced the information content of the films in comparison with the usual radiography. In their present state of development, the equidensity methods were not suitable for the testing of material. (HBG)

5049 EXTENSION OF DEPICTABLE OBJECT SIZE WITH GAMMA RADIATION. X. Comparison of the Methods. Becker, E. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 9: No. 5, 185-187(May 1973). (In German).

From the standpoint of practical application to the testing of materials, radiographic films were prepared and evaluated according to eleven different methods. An enhanced and enlarged extraction of information was obtained by only three methods: chemical reducer, general copying, and face shield mat copying. The three types of procedures, which yielded approximately the same degree of improvement, were compared with respect to economy, time requirements, and special applications. For the recognition of fine details in materials differing strongly in thickness, the chemical reducer method appeared most efficient and least expensive. In that particular case, the original radiograph must be intentionally overexposed. (HBG)

5050 RADIOGRAPHY USING SCATTERED GAMMA-RAYS. Tsujii, Y.; Furuta, J.; Hiraoka, E. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 104-107(1972).

A method of radiographic inspection of a lining material attached to a concrete wall back scattered radiation generated in the concrete is described. The image quality of the radiograph taken by this method is not better than the usual one, but the fundamental data show the possibility of using this method for the inspection of metal lining. (auth)

5051 METHOD FOR THE REMOTE CONTROL EXPOSING OF A FILM INTEGRATED INTO THE IRRADIATION CASSETTE OF A NEUTRONOGRAPHY CONVERTER AND THE CORRESPONDING EQUIPMENT. Farny, G.; Mourain, M. (to Commissariat a l'Energie Atomique). French Patent 2,148,781. 3 Aug 1971. 8p. (In French).

A process is presented for exposing the converter of a neutron radiography system. The converter is exposed in a cassette to irradiation, a film is introduced into this cassette, a biological shielding being interposed between the converter and the experimenter. The irradiation cassette also serves as an exposing cassette. The converter is made of indium or dysprosium and fixed on a stiffening support which pivots about pivoting parts provided in the casing. This system operates in air contained in an air chamber. (FR)

5052 IMPROVEMENTS TO IMAGE INTENSIFIER TUBES USED IN RADIOGRAPHY. Chalmeton, V. (to Laboratoires d'Electronique et de Physique Appliquee). French Patent 2,148,833. 5 Aug 1971. 6p. (In French).

An image intensifier device for radiography is proposed. It consists of a lead screen, a microchannel wafer type secondary emission amplifier and a phosphorescent screen. The lead screen is placed directly against the microchannel wafer. The screen material can be lead, tantalum or polonium. The lead screen produces high energy electrons under the impact of the incident x-rays. These electrons produce other electrons in multiplication processes in the microchannel wafer. Acceleration then takes place in the accelerating space separating the microchannel wafer and the phosphorescent screen. After their production, the electron paths are kept small, diffusion effects are thus reduced, and a very high resolving power is subsequently achieved. An improvement in brilliance amplification and the detection efficiency of the microchannel wafer may be obtained by interposing a high secondary emission layer between the screen (made of a high atomic number material) and the microchannel wafer. The image obtained possesses an excellent resolution and can be examined visually or photographically or handled by television. (FR)

5053 DETERMINATION OF DIRECTIONAL ELASTOMECHANICAL PROPERTIES BY MEANS OF ULTRASOUND AT DIFFERENT TEMPERATURES. Wawra, H. H. Materialpruefung; 15: No. 10, 349-353(1973). (In German).

The E modul, G modul and Poisson number have been determined for the first time from ultrasonic testing with regard to testing direction, profile size and temperature. This ultrasonic testing of elastomechanical properties gives important results for the prediction of strains, textures, porosities, etc. The applied elastomechanics is demonstrated in detail by means of 2,000 elasticity values for UO_2 monocrystals. (GE)

5054 TIME-RESOLVED NEUTRON RADIOGRAPHY. Aseltine, C. L.; Strich, R. A. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Trans. Amer. Nucl. Soc.; 17: 88-89(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5055 EXPOSURE NECESSARY TO DISCERN DETAIL IN UNSHARP NEUTRON RADIOGRAPHS. Hawkesworth, M. R. (Univ. of Birmingham, Eng.). Trans. Amer. Nucl. Soc.; 17: 90-91(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5056 IMPROVING LOW-FLUX IMAGING CAPABILITIES BY FILM COOLING. Swinth, K. L. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 91-92(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5057 NEUTRON RADIOGRAPHY OF SODIUM COLD TRAPS. Berger, H.; Lapinski, N. P.; McKee, J. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 164-165(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5058 RADIOGRAPHIC METHOD FOR INSPECTION OF COMPLETE FUEL SUBASSEMBLIES. Lapinski, N. P.; Berger, H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 178-179(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Explosions

Refer also to abstract 6449.

5059 (CALT-767-P-10-X-1) TECTONIC STRAIN MEASUREMENTS AT THE NEVADA TEST SITE. Final Report. (California Inst. of Tech., Pasadena (USA). Seismological Lab.). Aug 1973. Contract AT(04-3)-767. 20p. Dep. NTIS $3.00.

A three-axis gravity strain gage with a sensitivity of 10^{-9} was installed in tunnel V 12 p at the Nevada Test Site and was operated

continuously from October 1968 to the present, August 1973. Recordings of underground explosions, associated aftershocks, and cavity collapse events were recorded, in addition to regional and teleseismic earthquake signals. The data collected were used with other similar data to determine magnitudes of the static changes in the strain field due to both explosions and earthquakes. For explosions it was concluded that observed static or quasi-static strain changes were due to a combination of several effects, including the quasi-static cavity overpressure produced by the explosion itself, the tectonic stress field changes due to introduction of the shock-produced shatter zone in the prestressed geologic medium, and, local strain changes at the observation point due to dynamic overloading of the faulted, jointed, and cracked medium which results in minor "block shifting" near the point of observation. Only the first two of these effects are of known significance for earthquake triggering. From the data obtained it was concluded that: strain changes fall off with distance as $1/R^3$ from the detonation point; this implies a maximum 15 to 20 km range from the explosion as a zone in which tectonic events could be triggered; and quasi-static and static changes are the principal contributors to the earthquake triggering phenomena. (auth)

5060 (CONF-731033-1) NUCLEAR STIMULATION OF GAS FIELDS. Randolph, P. L. (El Paso Natural Gas Co., Tex. (USA)). 1 Sep 1973. 23p. Dep. NTIS $3.25.

From National Technical Canadian Gas Association; Calgary, Alberta, Canada (17 Oct 1973).

The technical bases of the emerging technology of nuclear stimulation of natural gas fields, the potential of this method for increasing the gas supply of the US, and public issues related to this technology are discussed. A technical appendix is provided with information on: reservoir producing characteristics; explosive design, availability, and cost; firing and space of explosives; economic parameters; and tabulated statistics on past and current projects on nuclear stimulation. (LCL)

5061 (EERL-TR-E-73-5) PROJECT DRUM INLET: EXPLOSIVE EXCAVATION IN SATURATED SAND. Snell, C. M.; Gillespie, R. H. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Oct 1973. 90p. Dep. NTIS $6.50.

Seasonal storms during February of 1971 completely closed the Drum Inlet navigation channel through the Outer Banks off the North Carolina coast. This channel is highly useful to commercial and sport fishing industries in the Carteret County vicinity of North Carolina, and is vital to maintenance of the ecological balance in the inland Core Sound waters. To reopen Drum Inlet, an alignment about 2.1 miles south of the original location was selected. A contract dredge excavated a channel from the inland Core Sound waterway to and part way through the Outer Banks. The final 385-ft-long section of sand separating the Core Sound from the Atlantic Ocean was excavated with large explosive charges. This report describes the explosive excavation of that portion of the channel. Twenty-two separate canisters, each containing 1 ton of aluminized ammonium-nitrate slurry blasting agent, were emplaced in two rows. All charges were detonated simultaneously at 1327 hours, 23 December 1971. The detonation successfully removed the sand barrier, forming a continuous channel over 80 ft in width. This channel subsequently washed out to a width of about 1000 ft and was used as an access route to the Raleigh Bay fishing grounds. The Drum Inlet project demonstrated the practicality of explosive channel excavation in saturated sand under the special conditions encountered at this site. (auth)

5062 (NVO-362-16) ANALYSIS OF PROJECT CANNIKIN PHOTOGRAPHS TO DETERMINE THE LOCATION OF OCEAN SURFACE EFFECTS. Preliminary Report. (General Motors Corp., Santa Barbara, Calif. (USA). Delco Electronics Div.). May 1972. Contract AT(26-1)-362. 29p. Dep. NTIS $3.50.

An analysis of selected aerial photographs taken during the CANNIKIN Event conducted at Amchitka Island, Aleutian Islands, November 1971 to determine the location of distinct disturbances that appear on photographs of the water surface, and to relate these to the topography or geomorphology conditions of the floor of the Bering Sea and Pacific Ocean is presented. The following are general findings that were drawn from study of the CANNIKIN aerial photographs. (These findings agree with early data from the Milrow Event.) The significant perturbations seen on the ocean surface are associated with sand bottoms. Well-defined and distinct turbulence, seen in the photographs as streaks of white water and geysers, were in all cases located over sand bottoms. The general "white water" condition which developed around them after a few milliseconds outlines the sandy areas. In fact, the absence of turbulence over known rock bottoms, even in areas of suspected geological faults, is quite apparent from study of the photographs. (auth)

5063 FORENSIC SEISMOLOGY. Thirlaway, H. I. S. (United Kingdom Atomic Energy Authority, Blacknest, Eng.). Quart. J. Roy. Astron. Soc.; 14: No. 3, 297-310(Sep 1973).

From 10th Harold Jeffreys lecture; London, Eng. (8 Dec 1972).

The application of seismology to the detection of distant nuclear explosions is discussed in the context of international attempts to find an acceptable formula for a comprehensive ban on nuclear weapons tests including underground explosions. The importance of establishing a completely reliable system, not only for detecting violations of a treaty but for distinguishing underground explosions from earthquakes, is emphasized. Examples are given of the problems of measurement and interpretation of results, using P-waves and Rayleigh waves. The effect of rock structures on the paths of the seismic waves is discussed, and current models of the Earth are examined in relation to seismology. (UK)

5064 CHEMICAL PROCESSING IN GEOTHERMAL NUCLEAR CHIMNEY. Krikorian, O. H. (to United States Atomic Energy Commission). US Patent 3,764,660. 9 Oct 1973. Filed date 17 May 1971. 16p.

A closed rubble filled nuclear chimney is provided in a subterranean geothermal formation by detonation of a nuclear explosive device therein, with reagent input and product output conduits connecting the chimney cavity with appropriate surface facilities. Such facilities will usually comprise reagent preparation, product recovery and recycle facilities. Processes are then conducted in the nuclear chimney which processes are facilitated by temperature, pressure, catalytic and other conditions existent or which are otherwise provided in the nuclear chimney. (auth)

5065 INDUSTRY'S APPRAISAL OF GAS STIMULATION. McHugh, R. C. (Colorado Interstate Gas., Colorado Springs). Trans. Amer. Nucl. Soc.; 17: 13(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5066 LEGAL AND ADMINISTRATIVE ASPECTS OF NATURAL-GAS STIMULATION. Fleming, E. H. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 13-14(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5067 ENVIRONMENTAL CONSIDERATIONS OF NUCLEAR STIMULATION OF NATURAL GAS. Willard, B. E. (Council on Environmental Quality, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 14(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5068 ACHIEVING PUBLIC ACCEPTANCE FOR PROJECT RIO BLANCO. Aronson, H. H.; Young, F. (CER Geonuclear Corp., Las Vegas, NV). Trans. Amer. Nucl. Soc.; 17: 15(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5069 CASE STUDY OF A REGIONAL GAS SUPPLY. Holzer, F. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 15-16(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5070 ALTERNATE METHODS FOR GAS STIMULATION. Elkins, L. E. (Amoco Production Co., Tulsa, OK). Trans. Amer. Nucl. Soc.; 17: 16(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5071 RIO BLANCO EXPERIMENT: ITS OBJECTIVES, DESIGN, AND EXECUTION. Luetkehans, G. (CER Geonuclear Corp., Las Vegas, NV); Pastore, R.; Toman, J. Trans. Amer. Nucl. Soc.; 17: 17(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5072 RIO BLANCO: NUCLEAR OPERATIONS AND CHIMNEY REENTRY. Woodruff, W. R.; Guido, R. S. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 17-18(Nov 1973).

From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5073 PROJECT RIO BLANCO WELL TESTING: A PRELIMINARY REPORT. Bray, B. G. (CER Geonuclear Corp., Las Vegas, NV); Mann, R. L. Trans. Amer. Nucl. Soc.; 17: 18-19(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5074 RIO BLANCO GAS QUALITY ANALYSIS AND EVALUATION PROGRAM: STATUS REPORT. Smith, C. F.; Taylor, R. W. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 19(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5075 RIO BLANCO EXPERIMENT: ATMOSPHERIC DIFFUSION STUDY OF FLARING GAS. Peterson, K. R. (Univ. of California, Livermore); Brundage, R. S. Trans. Amer. Nucl. Soc.; 17: 19(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5076 HYDROLOGY OF THE RIO BLANCO SITE. Knutson, C. F. (CER Geonuclear Corp., Las Vegas, NV); Bredehoeft, J. D.; Gonzales, D. D.; Weeks, J. B.; Weir, J. E. Jr.; Welder, F. A. Trans. Amer. Nucl. Soc.; 17: 19-20(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5077 RIO BLANCO EXPERIMENT: SUBSURFACE AND SURFACE EFFECTS AND MEASUREMENTS. Toman, J.; Sisemore, C.; Terhune, R. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 21-22(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5078 PROJECT RIO BLANCO: GROUND MOTION. Alcock, E. D. (CER Geonuclear Corp., Las Vegas, NV). Trans. Amer. Nucl. Soc.; 17: 22(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5079 PROJECT RIO BLANCO: STRUCTURAL RESPONSE STUDIES, BRACING, AND DAMAGE. Medearis, K. (Kenneth Medearis Associates, Ft. Collins, CO). Trans. Amer. Nucl. Soc.; 17: 22-23(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5080 MODIFICATION OF THE COLONY TOWER FOR THE RIO BLANCO DETONATION. Blume, J. A.; Lee, L. A.; Freeman, S. A.; Honda, K. K. (John A. Blume Associates, San Francisco). Trans. Amer. Nucl. Soc.; 17: 23(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5081 PROJECT RIO BLANCO: OBSERVATIONS OF PORE PRESSURE ENHANCEMENT. Banister, J. R.; Ellett, D. M. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 17: 23(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5082 PROJECT RIO BLANCO: IN SITU SOIL PORE PRESSURE MEASUREMENTS. Winters, L.; Benoist, J. (Dames and Moore, San Francisco). Trans. Amer. Nucl. Soc.; 17: 24-25(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5083 NUCLEAR OFFSHORE STORAGE FOR LIQUID HYDROCARBONS. Despois, J. (CEA, Paris); Nougaredo, F.; Pralong, Y.; Sards, J. P. Trans. Amer. Nucl. Soc.; 17: 26(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5084 GASBUGGY 1973 PRODUCTION TESTING. Chew, E. W.; Randolph, P. L. (El Paso Natural Gas Co., TX). Trans. Amer. Nucl. Soc.; 17: 26-27(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5085 EVOLUTION OF TEMPERATURE AND RADIOACTIVITY IN NUCLEAR CAVITY. DuPuis, M. C.; Cousigne, M. M.; Humbert-Droz, M. C. (CEA, Paris). Trans. Amer. Nucl. Soc.; 17: 27(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5086 EFFECT OF PHYSICAL SHOCK ON DEVELOPING SALMONID EGGS. Post, G. (Colorado State Univ., Fort Collins); Power, D. V.; Kloppel, T. M. Trans. Amer. Nucl. Soc.; 17: 27-28(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5087 COMPUTER DESIGN OF HIGH-EXPLOSIVE EXPERIMENTS TO SIMULATE SUBSURFACE NUCLEAR DETONATIONS. Burton, D. E.; Snell, C. M.; Bryan, J. B. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 28-29(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5088 DIRECTED BLASTING: PRINCIPLES AND APPLICATION. Lattery, J. E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 29(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5089 EXPLOSIVE EXCAVATION OF NAVIGATION HAZARDS IN THE STRAIT OF TIRAN BETWEEN THE GULF OF EILAT AND THE RED SEA. Elron, Y.; Kruger, P. (Stanford Univ., CA). Trans. Amer. Nucl. Soc.; 17: 30(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5090 NUCLEAR EXPLOSION ENGINEERING: 1973. Kruger, P. (Stanford Univ., CA). Trans. Amer. Nucl. Soc.; 17: 57(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Protective Structures and Equipment

Refer also to abstract 5312.

5091 MUTUAL SHIELDING OF OCCUPANTS IN RESIDENTIAL HOME BASEMENTS. Cohen, M. O.; Beer, M. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 565-566(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Vacuum Engineering

5092 APPARATUS WITH HEATED DIFFUSION PUMP VAK-2 FOR OBTAINING A VACUUM BETTER THAN 10^{-10} MM Hg. Grishin, S. F.; Chernyshenko, V. Ya.; Kirichek, I. R. pp 228-232 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).
A superhigh vacuum apparatus with heated diffusion pump was developed and investigated. Preliminary evacuation was done with the M-40 diffusion pump. The high-vacuum part of the apparatus can be heated up to 400°C. The rate of evacuation of the apparatus is about 2×10^3 l/sec in nitrogen. Without heating a vacuum of 7×10^{-10} mm Hg was obtained with the apparatus. The use of transient heating made it possible to obtain a vacuum of about 1×10^{-11} mm Hg. A small quantity of cryogenic liquids was required for operation of the apparatus. (tr-auth)

ENVIRONMENTAL AND EARTH SCIENCES

5093 (NIRS-12) ANNUAL REPORT, 1972. (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1972. 78p. Dep. NTIS (U. S. Sales Only) $6.00.

Brief summaries are presented of research performed in Japan during 1972 in the fields of physics, chemistry, biology, medicine, and environmental sciences. (CH)

Minerals and Ores

Refer also to abstracts 4834, 4836, 4837, 4881, and 5136.

5094 (NP-19868) URANIUM RESOURCES, PRODUCTION, AND DEMAND. (Organization for Economic Co-Operation and Development, Paris (France); International Atomic Energy Agency, Vienna (Austria)). Aug 1973. 137p.

Reasonably assured world uranium resources under $10/lb U_3O_8 now amount to 866,000 tonnes uranium (1,126,000 short tons U_3O_8), an increase of about one-third over the past three years. Annual production of U_3O_8 has remained fairly stable during this period, attaining a modest increase of about 10 per cent to a 1972 total of something over 19,000 tonnes uranium (25,000 short tons U_3O_8). Annual production capacity is planned to reach about 30,000 tonnes uranium (40,000 short tons U_3O_8) by 1975 and could attain about 50,000 tonnes uranium (65,000 short tons U_3O_8) by 1978. (auth)

5095 URANIUM-234. Cherdyntsev, V. V. New York; John Wiley and Sons, Inc. (1971). 239p. (IPST-Cat.-2313). $19.50.

Translation of Uran-234 by J. Schmorak.

The following subjects are discussed: ^{234}U and other natural radioactive isotopes, fractionation of heavy radioactive elements in nature, fractionation of radioactive isotopes, ^{234}U in nuclear geochemistry, ^{234}U in uranium minerals, ^{234}U in continental waters and in quaternary deposits, and ^{234}U in the ocean. (LK)

5096 STABLE ISOTOPE GEOCHEMISTRY. Hoefs, J. Minerals, Rocks, and Inorganic Materials. Monograph Series of Theoretical and Experimental Studies, Volume 9. New York; Springer-Verlag New York, Inc. (1973). 151p. $14.50.

The book is divided into three parts. Section A gives the theory of isotope effects and the technical background. Section B gives a summary of the fractionation mechanisms affecting the most important elements—hydrogen, carbon, oxygen, and sulfur. Other elements that have not yet been thoroughly investigated are also surveyed. Section C surveys the most important results from a geological standpoint. (DHM)

Radioactive Effluents

Refer also to abstracts 5139, 6858, and 7167.

5097 CONCENTRATIONS OF POLLUTANTS ACCUMULATED IN ONE HOUR CAUSED BY EMISSIONS AT A SINGLE POINT NEAR THE GROUND: PROBABILISTIC PRESENTATION. Le Quinio, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 215-222 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Numerous atmospheric diffusion experiments have been carried out in the last decade at some ten French reactor sites. For sources near the ground (0 to 50 m) values of maximum concentration made at 2.5 km and 11 km follow log-normal laws showing substantially the same standard deviations. From this one can deduce directly, and not by more or less representative calculations, the probability for exceeding predetermined concentrations. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 4835, 5141, and 7381.

5098 (A/CONF.48-14) UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT, STOCKHOLM, JUNE 5–16, 1972. (United Nations, New York (USA)). 3 Jul 1972. 145p. (CONF-720621-). Dep. NTIS (U. S. Sales Only) $9.25.

Recommendations of the working group of the United Nations conference on the preservation and improvement of the human environment are presented. Emphasis was placed on conservation of natural resources. (CH)

5099 (BNWL-SA-4694) NATURAL IODINE AND IODINE-129 IN MAMMALIAN THYROIDS AND ENVIRONMENTAL SAMPLES TAKEN FROM LOCATIONS IN THE UNITED STATES. Brauer, F. P.; Soldat, J. K.; Tenny, H.; Strebin, R. S. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 28p. (CONF-731117-1; SM-180/34). Dep. NTIS $3.50.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Bovine and other mammalian thyroids, air, precipitation, water, grass, and milk samples from selected locations were analyzed for their natural iodine and iodine-129 content. Particle filters and activated charcoal beds were used to collect the particulate and gaseous iodine fractions from the air. Anion exchange was used for the separation of iodine from liquid samples. Combustion methods were used for iodine separation from solid samples, anion exchange resins, and air filters. Iodine-129 and natural iodine concentrations were determined by neutron activation analysis with a detection limit of about 10^8 atoms of iodine-129 per sample. Analytical results of both ^{129}I concentrations and ratios of atoms of ^{129}I per atom of ^{127}I for these samples are summarized. The small radiation doses to human thyroids projected from these low ^{129}I concentrations are also discussed. (auth)

5100 (COO-3573-5) COMMENTS PREPARED FOR THE SENATE COMMERCE COMMITTEE, SUBCOMMITTEE ON OCEANS AND ATMOSPHERES. Turekian, K. K. (Yale Univ., New Haven, Conn. (USA)). 1973. 4p. (CONF-730663-1). Dep. NTIS $3.00.

The need for criteria for the proper management of ocean resources is emphasized. It is stressed that research on the natural oceanic system must accompany any attempts at regulating the use of oceans by man. (CH)

5101 (INIS-mf-162) ENVIRONMENTAL RADIOACTIVITY AND RADIATION PROTECTION. Measurements in Hamburg, 1968 and 1969. (Gesundheitsbehoerde, Hamburg (F. R. Germany)). 1970. 27p. INIS.

Radioactivity levels in precipitations, surface waters, sewage, drinking water, and foods sampled in Hamburg during 1968 and 1969 are presented. Personnel dosimetry values and leak testing of sealed radiation sources are reported. (INIS)

5102 (INIS-mf-579) COMPARISON OF THE INFLUENCE ON THE ENVIRONMENT OF NUCLEAR AND OTHER INDUSTRIES. Recht, P. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 25p. (In French). INIS.

The problems resulting from the discharge of radioactive effluents in the environment are well known and the resulting doses of radiation received by the population were calculated both for the present time and for the year 2000 when world production of nuclear electricity will be 200 times the actual output. The problems raised by the substances emanating from non-nuclear power plants, and especially those due to sulfur dioxide, nitrogen oxides, and dust are considered. This pollution is measured regularly in the European countries. The comparison favors the use of nuclear energy, provided that careful attention is paid to safety and that efforts are made in the technological field to find a satisfactory solution to the problems of health protection caused by high-activity waste containing radionuclides with a long half-life. (INIS)

5103 (LBL-2195) ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS AROUND REACTORS: PRE-OPERATIONAL, OPERATIONAL, AND FOR ACCIDENTS. Budnitz, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 23p. Dep. NTIS $3.25.

A general overview is given of the requirements for environmental monitoring programs around nuclear power reactors. The emphasis is on radiological measurements in three types of environmental measurement situations: pre-operational; operational; and during accidents and accidental releases. The goals of the various programs are outlined, along with the relevant regulations. Discussions of the sampling part of each program are included, along with some comments on the choice, deployment, and use of instrumentation. Other sources must be consulted for detailed discussions of instruments and analytical techniques. The

goal is to give some insight into the complexities of environmental monitoring programs. The difficulties involved in establishing a viable program should not be thought of as insurmountable: on the contrary, many skilled personnel are easily capable of carrying out these sampling and measuring programs, including the occurrence of unexpected demands from time to time. (auth)

5104 (SCPRI(RM)-5-1973) REPORT OF ACTIVITY, MAY 1973. (Service Central de Protection contre les Rayonnements Ionisants, 78-Le Vesinet (France)). 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI presents the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr, and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

5105 (SCPRI(RM)-5-1973(Suppl.)) ANNEX TO MONTHLY REPORT, MAY 1973. Detail of Results of Measurement. (Service Central de Protection Contre les Rayonnements Ionisants, 78-Le Vesinet (France)). 1973. 23p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Measurement tables concerning the radiation monitoring of the environment in France are presented. (FR)

5106 (SCPRI(RM)-6-1973) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Jun 1973. 19p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Results are reported concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

5107 (SCPRI(RM)-6-1973(Suppl.)) DETAILS OF THE RESULTS OF MEASUREMENTS. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Jun 1973. 30p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

Tabulated data are presented on levels of radioactivity in environmental samples on France during June 1973. (FR)

5108 (WASH-1256) SUMMARY REPORT ON THE ASSESSMENT OF ENVIRONMENTAL RADIOACTIVITY IN THE VICINITY OF THE SHIPPINGPORT POWER STATION. (USAEC Division of Operational Safety, Washington, D. C.). May 1973. 80p. Dep. NTIS $6.00.

Results are reported from an interagency radiation monitoring survey of the area surrounding the Shippingport Atomic Power Station conducted during 1973. The reactor has a closed cycle pressurized water cooling system and operates at about 100 MW(e). The station achieved full power on December 23, 1957, and has operated continuously, except for routine shutdowns for maintenance and refueling. Operating data relative to possible radioactivity releases were evaluated by the Regulatory staff, preoperational survey data were evaluated by the AEC Division of Biomedical and Environmental Research, aerial radiation monitoring was carried out by Division of Operational Safety, the Environmental Protection Agency (EPA) conducted a ground level environmental survey of the area, and the Division of Naval Reactors carried out on analysis of waste disposal data. The AEC Health and Safety Laboratory reviewed all the survey data. Results provided evidence that the reactor has not contaminated the environment. Analysis of primary coolant and waste streams, including samples drawn and analyzed by the EPA and the State of Pennsylvania, indicate that radioactivity releases have been extremely low, with gaseous discharges totaling less than one millicure per year since 1967. The survey results disclosed only background levels of radioactivity in the vicinity of the Station. (CH)

5109 EVENTUAL GREAT LAKES RADIOLOGICAL IMPACT DUE TO NUCLEAR POWER GENERATION. Martin, D. E. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 17: 62-63(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5110 ENVIRONMENTAL RADIATION MONITORING. Kahn, B. (Environmental Protection Agency, Cincinnati). Trans. Amer. Nucl. Soc.; 17: 536(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5111 MODELS FOR CALCULATION OF ENVIRONMENTAL RADIATION DOSES. Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 536-537 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5112 INTERPRETABILITY OF TLD MEASUREMENTS MADE IN THE ENVIRONS OF A NUCLEAR POWER REACTOR. Burke, G. deP.; Marcin, D. G. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 17: 537-538(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5113 AERIAL RADIOLOGICAL SURVEY OF ENIWETOK ATOLL. Stuart, T. P. (EG and G, Inc., Las Vegas, NV); Hendricks, T. J.; Gudiksen, P. H.; Jones, D. E.; Lynch, O. D. T. Trans. Amer. Nucl. Soc.; 17: 540(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5114 AERIAL MEASUREMENT OF 5% DIFFERENCES IN TERRESTRIAL BACKGROUND RADIATION. Boyns, P. K. (EG and G, Inc., Las Vegas, NV). Trans. Amer. Nucl. Soc.; 17: 540-541(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Atmosphere

Refer also to abstract 5137.

5115 (BNWL-SA-4819) SOME INFLUENCES OF REGIONAL BOUNDARY LAYER FLOW ON ATMOSPHERIC TRANSPORT AND DISPERSION. Wendell, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 24p. (CONF-731205-2). Dep. NTIS $3.25.

From American Chemical Society 2nd joint conference on sensing of environmental pollutants; Washington, District of Columbia, USA (10 Dec 1973).

The scales on which most atmospheric transport and diffusion work has been carried out have been either on the order of less than a few kilometers or over a few hundred kilometers. Only recently has serious attention been turned to the intermediate scale on the order of a few tens of kilometers. It is on this regional scale in the boundary layer of the atmosphere that air pollution problems are becoming more critical. Recent investigations in several areas of the western United States have shown that the atmospheric transport of pollutants is strongly affected by intermediate scale variations in the topography. This spatial variation in the flow can cause short term emergency forecasts of plume transport or long term site evaluation studies based only on the source winds to be seriously in error. Instances of severe vertical shear in wind speed and direction may also be traced back to regional scale variation in terrain height. (auth)

5116 (MLM-2083(OP)) MOUND LABORATORY AIR SURVEILLANCE SYSTEM. Hebb, J. L. (Mound Lab., Miamisburg, Ohio (USA)). [nd]. Contract AT-33-1-GEN-53. 6p. (CONF-731110-2; SM-181/20). Dep. NTIS $3.00.

From symposium on the physical behavior of radioactive containment in the atmosphere; Vienna, Austria (12 Nov 1973).

The approach used to achieve the technical requirements for a Mound Laboratory air surveillance system which would be acceptable to the public community is described. Information is included on: selection of components for the overall air surveillance system; programs undertaken in cooperation with local government agencies already engaged in pollution monitoring; and public information activities to keep the local population informed about the surveillance system. (LCL)

5117 (NP-19750) MEASUREMENT OF THE RADIOACTIVITY IN THE ATMOSPHERE IN THE YEAR 1972: SALZBURG WEATHER STATION. (Zentralanstalt fuer Meteorologie und Geodynamik,

Vienna (Austria)). 1972. 13p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Data are tabulated on the monthly levels of radioactivity in air samples collected during 1972 at the Salzburg weather station, West Germany. (CH)

5118 (NP-19752) MEASUREMENT OF THE RADIOACTIVITY IN THE ATMOSPHERE IN THE YEAR 1972: KLAGENFURT WEATHER STATION. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). 1972. 13p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Data are tabulated on the monthly levels of radioactivity in air samples collected during 1972 at the Klagenfurt weather station, West Germany. (CH)

5119 (NP-19754) MEASUREMENT OF THE RADIOACTIVITY IN THE ATMOSPHERE IN THE YEAR 1972: BREGENZ WEATHER OBSERVATION STATION. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). 1972. 12p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Data are tabulated on the monthly levels of radioactivity in air samples collected during 1972 at the Bregenz weather station, West Germany. (CH)

5120 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 9, 548-556(Sep 1973).

Data are presented on the gross β radioactivity in surface air particulates and precipitation samples collected throughout the United States and at selected sites throughout the Western Hemisphere during May 1973. (CH)

5121 RADIOCHEMICAL STUDY OF ATMOSPHERIC DEBRIS FROM RECENT NUCLEAR TESTS. Moore, D. T. Fayetteville, AR; Univ. of Arkansas (1973). 119p. University Microfilms Order No. 73-27,434.

Thesis (Ph. D.).

The concentration variation and radiochemical nature of the radioactive debris observed in ground-level air filters and precipitation samples following the 12th (November 18, 1971), 13th (January 7, 1972), and 14th (March 18, 1972) Chinese nuclear test explosions was studied. The debris from the 12th test was found to be enriched in the volatile mass chains and no particles large enough to be seen by x-ray autoradiography were observed. It is postulated that this was the result of the northern location of the jet stream or that the debris observed resulted from a vented underground test. The fallout from the 13th test was typical of a tropospheric injection of debris and the effect lasted only for about five weeks. However, the fallout from the 14th test persisted for about five months, until August 1972, indicating that the debris entered the stratosphere. The diameters of individual hot particles ranged from about 0.1 to 7 microns in diameter, but a single large (34 μ) particle was found on March 23, 1972. Radiochemical studies were made on this particle, in which the fission products belonging to the volatile mass chains 89, 90, 91, 140, and 141 were highly depleted. The formation-interval (Ξ) of this particle was calculated from the extent to which these mass chains were depleted. A value very close to $\Xi = 0$ (seconds) was obtained from the mass 91 chain, but no positive Ξ values could be calculated from the 140 and 141 chains. This discrepancy was explained, by examining the fractionation-factors for these chains for this particle and others, as being due to the difference in the melting points of the oxides of the elements belonging to the fission product decay chains. (Diss. Abstr. Int., B)

5122 LONG-LIVED RADON DAUGHTERS AS ATMOSPHERIC RADIOACTIVE TRACERS. Nevissi, A. Fayetteville, AR; Univ. of Arkansas (1973). 89p. University Microfilms Order No. 73-27,436.

Thesis (Ph. D.).

Three simultaneous studies were undertaken to investigate the mean tropospheric aerosol residence time by measuring the activity of the long-lived radon decay products, namely, ^{210}Pb, ^{210}Bi, and ^{210}Po in the atmosphere. The residence time was determined from the ^{210}Bi/^{210}Pb and ^{210}Po/^{210}Pb activity ratios, the residence times calculated from the two ratios were compared to decide under which conditions the residence time values are concordant and the reason for discordant residence times, and washout ratios were determined. In the first study, the activities of ^{210}Pb, ^{210}Bi and ^{210}Po were measured in a large number of rain and snow samples that fell at Fayetteville, Arkansas. The experimental results show an average aerosols residence time of about 30 days, which is in good agreement with the values observed for the fission products and cosmic-ray produced nuclides. In nearly 82% of the samples measured the residence times calculated from the ^{210}Bi/^{210}Pb and ^{210}Po/^{210}Pb ratios were either concordant or near concordant. The discordant residence times are shown to result from the mixing of different air masses, which results in the failure of the assumption of steady state atmospheric conditions. During the last of these studies the washout ratios for ^{210}Pb were measured for a number of rains that fell at Fayetteville, Arkansas. It is concluded that the activity of the ground level air is not always representative of the activity of the troposphere from the height of rain generating clouds to the sampling level unless there is complete vertical mixing. (Diss. Abstr. Int., B)

5123 WORLDWIDE CLIMATOLOGICAL STUDY OF GROUND-LEVEL ATMOSPHERIC DISPERSION PARAMETERS. Chandler, M. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 17: 67-68(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5124 LOS ALAMOS SCIENTIFIC LABORATORY'S ENVIRONMENTAL MONITORING PROGRAM: AN OVERVIEW WITH EMPHASIS ON ENVIRONMENTAL DOSIMETRY. Herceg, J. E.; Johnson, L. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 541-542(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5125 ENVIRONMENTAL MESON DOSIMETRY. Gold, R. (Joint Center for Graduate Study, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 542(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5126 AUTOMATIC DATA HANDLING SYSTEM FOR LOW-LEVEL ENVIRONMENTAL RADIATION MONITORING. Voilleque, P. G. (Atomic Energy Commission, Idaho Falls, ID); Hill, D. G.; Tillitt, D. N. Trans. Amer. Nucl. Soc.; 17: 543-544(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Water

5127 (ORO-23) RADIOACTIVITY TRANSPORT IN WATER: FINAL REPORT. Technical Report No. 22. Gromiec, M. J.; Gloyna, E. F. (Texas Univ., Austin (USA). Center for Research in Water Resources). Jun 1973. Contract AT(11-1)-490. 80p. (EHE-73-1; CRWR-97). Dep. NTIS $6.00.

Studies were undertaken to obtain a more accurate concept of the transport of radionuclides in aquatic systems. Various stages of this research were completed and published previously in progress reports, and are listed in the references. These reports describe the dispersion, uptake, release, and transport of ^{85}Sr, ^{137}Cs, ^{103}Ru, ^{58}Co, and ^{51}Cr. Transport data were obtained by conducting laboratory, model river, and field tests. Canal, river, and estuarine environments provided the necessary field information on hydrodynamic dispersion and on uptake and release of radionuclides by sediments. Model river data provided most of the useful uptake and release information involving special sediments, plants, and aquatic environments. Topics discussed include the factors affecting radionuclide transport, the use of model rivers to study continuous release of radionuclides, and the influence of various environmental factors on the accumulation and desorption of mercurials by a fresh water alga. Radioactive isotopes of mercury in the form of mercuric mercury and methyl mercury were used as tracers. (CH)

5128 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 9, 542-547(Sep 1973).

Data are presented on the gross β radioactivity of samples of drinking water and surface waters collected at various locations throughout the USA during December 1972. (CH)

5129 ENVIRONMENTAL MONITORING AND DISPOSAL OF RADIOACTIVE WASTES FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES, 1972. Miles, M. E.; Sjoblom, G. L. (Dept. of the Navy, Washington, DC). Radiat. Data Rep.; 14: No. 9, 517-525(Sep 1973).

The environmental effect of disposal of radioactive wastes originating from U. S. Naval nuclear propulsion plants and their support facilities is assessed. The total radioactivity discharged to all ports and harbors from the more than 100 nuclear-powered ships and supporting tenders, bases and shipyards was less than 0.002 curie in 1972. This report confirms that procedures used by the Navy to control releases of radioactivity from U. S. Naval nuclear-powered ships and their support facilities are effective

in protecting the environment and the health and safety of the general public. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 7068, 7069, and 7401.

5130 RAPID DRY ASHING OF FOODSTUFFS. Boppel, B. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Anal. Chem.; 266: No. 4, 257-263(1973). (In German).

From IAEA-symposium on rapid methods for measuring radioactivity in the environment; Munich, Germany (1971).

Control of foodstuffs with respect to radioactivity requires in many cases previous ashing of the samples. A method for dry ashing is described that requires little time. It is possible to ash a 500 to 1,000 g sample of water-containing food (fruits, vegetables etc.) as well as liquid food (milk, fruit juices etc.) without previous drying in 30 to 90 min at about 500°C. Interactions between the moist and liquid foodstuffs and the stainless steel ashing vessels during the ashing were avoided by using appropriate inert layers. The temperature increase of the samples generated by oxidation processes was measured by immersed thermocouples. Because of the volatility of certain inorganic constituents, knowledge of the temperature change in the ashed sample is important. The degree of volatility and the influence of the ashing temperature on the acid solubility of some nuclides were measured. Of the 12 elements investigated, only the Ru/Rh isotopes exhibited a pronounced dependence of the acid solubility on the ashing temperature. (auth)

5131 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 9, 527-541(Sep 1973).

Data are reported on the content of fallout ^{140}Ba, ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr in samples of milk collected throughout the United States and other selected sites in the Western Hemisphere during May, 1973. (CH)

5132 ECOLOGY, TECHNOLOGY, AND SOCIAL ACTION: AN INTERDISCIPLINARY TEACHING PROGRAM. Meyer, W. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 17: 55-56(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiometric Techniques

Refer also to abstracts 4830, 4836, 5103, and 5137.

5133 (COO-3236-6, pp 19-23) URANIUM–THORIUM–LEAD DATING OF METEORITES. Lancet, M. S. 31 May 1973.

In nuclear chemistry and geochemistry research.

Research progress is reported on uranium–thorium–lead dating of meteorites and research is proposed for the following areas: whole-rock measurement (chondrites and achondrites) and internal isochron measurements. (DHM)

5134 (EGG-1183-1615) AREAL SNOWPACK WATER-EQUIVALENT DETERMINATIONS USING AIRBORNE MEASUREMENTS OF PASSIVE TERRESTRIAL GAMMA RADIATION. Jones, E. B.; Fritzsche, A. E.; Burson, Z. G.; Burge, D. L. (EG and G, Inc., Las Vegas, Nev. (USA)). 1973. 11p. (CONF-731201-1). Dep. NTIS $3.00.

From symposium on advanced concepts and techniques in the study of snow and ice resources; Monterey, California, USA (2 Dec 1973).

Airborne measurement of the areal average of the water equivalent of snow by the terrestrial gamma attenuation method is accurate to 1.2 cm or 10% whichever is greater. Airborne survey data from study areas in the midwest show that airborne radon daughters, soil moisture, and gamma counting statistics are the predominant sources of error. The method has good potential for large, rapid areal measurements of water equivalent over flat or rolling terrain. (auth)

5135 METHOD OF DETERMINING THE WATER-PETROLEUM INTERFACE FROM THE $^{13}C(\gamma,n)^{12}C$ REACTION WITH THE USE OF A 6 TO 8 MeV ELECTRON BEAM. Dorosh, M. M.; Parlag, A. M.; Shkoda-Ul'yanov, V. A.; Danilich, I. I.; Mazur, V. M.; Ugrin, A. Yu. At. Energ. (USSR); 34: No. 6, 485-487(Jun 1973). (In Russian).

Oil-bearing strata differ from water-bearing strata in ^{13}C content. The deuterium content in oil strata exceeds by 50% or more the deuterium content in water strata. Hence a larger yield of photoneutrons is expected from an oil-bearing stratum, especially since the yield of photoneutrons from the $^{17}O(\gamma,n)^{16}O$ reaction turns out to be insignificant. In order to model an encased borehole, measurements were taken on the following mixtures: 70% SiO_2 + 30% H_2O (water-bearing stratum) and 70% SiO_2 + 30% oil (oil-bearing stratum), and also on pure water and oil (ratio of components are given in vol %). The mixtures were placed in a metal tank 42 × 42 × 42 cm. The bremsstrahlung radiation struck the tank from a side covered with 3 cm concrete (2.4 g/cm^3 density) and an iron sheet 8 mm thick to imitate the steel tube and cement collar. The photoneutrons were registered on a BF_3 counter which was in the field of scattering of the 6.5 to 8.6 MeV gamma radiation at a distance of 20 cm from the beam axis. With 8.1 MeV gamma rays the neutron yield from the oil-bearing layer exceeded the neutron yield from the water-bearing layer by ~50% for an uncased borehole, and by ~30% for a simulated cased borehole. (SJR)

5136 ABSOLUTE AGE RELATIONSHIPS IN SELECTED COLORADO PLATEAU URANIUM ORES. Berglof, W. R. Columbia, NY; Columbia Univ. (1973). 150p. University Microfilms Order No. 73-27,329.

Thesis (Ph. D.).

New lead–uranium isotopic ages for primary minerals, together with geologic evidence, suggest several periods of ore deposition in uranium-bearing strata of the Colorado Plateau. Concordant age sequences, where the apparent ages derived from the ratios $^{206}Pb/^{238}U$, $^{207}Pb/^{235}U$, and $^{207}Pb/^{206}Pb$ agree within the experimental error, have been obtained for uraninite from the Upper Jurassic Todilto Limestone, near Grants, New Mexico, and the Upper Triassic Chinle Formation, near Moab, Utah. These ages are about 150 m.y. and 200 m.y., respectively, and agree with the independently estimated absolute age of the host rocks, suggesting mineralization shortly after sedimentation, as geologic evidence apparently precludes strict syngenesis. For Todilto deposits, evidence against syngenesis includes cross-cutting relationships, occasional fracture control of ore, and localization of ore bodies by intraformational folds which formed after sedimentation but before complete lithification. Ages for coffinite from the Jackpile mine area, near Laguna, New Mexico, together with geologic evidence, indicate mineralization of the Upper Jurassic Morrison Formation during the Lower Cretaceous. Primary deposits in the Morrison in the Ambrosia Lake district, near Grants, New Mexico, probably formed contemporaneously with the Jackpile deposits. Mineralization of the Todilto Limestone apparently preceded deposition of the ore-bearing Morrison Formation in the Grants-Laguna district. At Kane Creek, Utah, essentially concordant ages for bedded and fracture-controlled deposits are about 200 m.y. and 60 m.y., respectively, also suggesting two different periods of ore formation in the same mineralized area. Plateau samples usually yield discordant apparent age sequences, which are generally best explained by partial loss of radiogenic lead, with preferential loss of ^{206}Pb. Loss of intermediate daughter products in the ^{238}U decay chain may have contributed to ^{206}Pb deficiencies. The possibility of old radiogenic lead contamination as a cause of discordance exists in some areas. Geologic evidence for extensive redistribution of relatively unoxidized ore exists at Ambrosia Lake, New Mexico. Discordant age sequences with $^{206}Pb/^{238}U$ and $^{207}Pb/^{235}U$ ages much less than the absolute age of the enclosing sediments have been obtained for apparently primary minerals from many deposits, some of which also yield virtually syngenetic ages. Concepts of origin of Plateau ores must be revised in light of the age data, but only the syngenetic hypothesis, among those previously proposed, seems to be ruled out by isotopic and geologic data. All previous hypotheses seem to be more readily applied to deposits in sandstone than to the deposits in the Todilto Limestone. (Diss. Abst. Int., B)

Site Surveys

Refer also to abstracts 7118–7123 and 7165.

5137 (ARMS-68.6.3) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING BIG ROCK POINT NUCLEAR PLANT, BIG ROCK POINT, MICHIGAN, 1968. Stevart, M. D. (EG and G, Inc., Las Vegas, Nev. (USA)). Oct 1973. 36p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS), operated for the U. S. Atomic Energy Commission, was used to perform aerial surveys of several operational and non-operational reactor sites during the summer months of 1968. The data collected on these surveys included aerial photographs of the installations, aerial radiation survey data consisting of exposure rates normalized to 3

feet above the ground plus gamma-ray spectral charts, effluent characterization for operational sites (intensity rates and isotope constituents), and pertinent descriptive information of the installation. This report presents the data collected on the Big Rock Point reactor survey. (auth)

5138 (BARC-677) GEO-HYDROLOGICAL CONDITIONS AT RADIOACTIVE SOLID WASTE MANAGEMENT SITE, TROMBAY, WITH SPECIAL REFERENCE TO PUMPING TEST STUDIES. Godse, V. B.; Mathur, R. K.; Singh, M.; Amalraj, R. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

Geological and hydrological data are presented on the radioactive solid waste storage and disposal site, Trombay, India. Data from pumping tests carried out in bore wells at the site revealed considerable variation in the hydrological characteristics of the substrata at various locations. Tests on groundwater permeability in weathered zones and fresh rock revealed that groundwater fluctuations in the area are seasonal and are directly affected by rainfall especially during the monsoon season. Groundwater contour maps of the area indicated that the general direction of groundwater flow is towards the bay. (CH)

5139 (BNWL-B-278) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR CY-1972. Bramson, P. E.; Corley, J. P.; Nees, W. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 70p. Dep. NTIS $5.45.

Data are summarized on radioactivity in environmental samples collected during 1972 within the Hanford plant boundaries, but excluding areas under the control of individual contractors. Some data are included on samples collected off-site. Data are included on the content of ^{90}Sr, tritium, and total α radioactivity in samples of Columbia River water, surface waters, and drinking water collected at various locations; the content of ^{131}I and gross α and β radioactivity in air samples collected both on-site and off-site; the content of ^{239}Pu in samples of soil and vegetation; and the content of ^{137}Cs, ^{90}Sr, ^{65}Zn, and ^{239}Pu in tissue samples of migratory waterfowl, native birds, deer, and other wild mammals. Aerial surveys of γ radioactivity were conducted at an altitude of 500 ft twice during 1972 and no unusual radioactivity was detected. Active, inactive, and retired radioactive waste burial sites were inspected for general physical condition and evidence of disturbance. (CH)

5140 (NP-19748) NUCLEAR POWER PLANT IN THE OSLOFJORD DISTRICT: THE BRENNTANGEN, VARDEAASEN, AND HURUM SITE AREAS. Audunson, T.; Dahl, F. E.; Land, J.; Haugen, I.; Nilsen, G.; Skulberg, O. (Norsk Institutt for Vannforskning, Oslo; Trondheim Univ. (Norway). Vassdrags- og Havnelaboratoriet). Jan 1973. 97p. (In Norwegian). Dep. NTIS (U.S. Sales Only) $7.00.

The biological and hydrophysical evaluations for three possible nuclear power plant sites in the Oslofjord district are presented. The first half of the report gives general information on the biological and hydrophysical conditions in the Oslofjord, and the arrangement, execution, and terminology of the recipient evaluations. In the second half, results of the investigations are summarized for the three sites; the conclusions are given in the final chapter. The temperature increase distribution due to cooling water release and the consequent biological effects, both on the algae formation, plankton, degree of eutrophy and on the commercial fisheries form the main themes of discussion. Releases of radioactive materials are not judged to be of primary significance. (NO)

5141 (NVO-123) PHYSICAL AND BIOLOGICAL EFFECTS: CANNIKIN. Merritt, M. L. (USAEC Nevada Operations Office, Las Vegas). Oct 1973. 106p. Dep. NTIS $5.45.

Data are presented from a survey of the effects of the Cannikin underground nuclear explosion, November 6, 1971, on Amchitka Island, Alaska. Data are included on surface disruption, ground shock, water pressure, hydrology, and seismic effects; radioactivity released; effects on the sea otter population and other marine life; effects on terrestrial vegetation; effects on fish in freshwater ponds and streams; and effects on bird populations. None of the observed effects were attributed to radiation. No radioactivity above normal background levels was found in air and biological samples. Tritiated water found in ponds was attributed to levels in the chimney pushed to the surface by rising water. (CH)

5142 (SLA-73-5966) PORE PRESSURE ENHANCEMENTS OBSERVED ON RIO BLANCO. Banister, J. R.; Ellett, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 29p. (CONF-731101-39). Dep. NTIS $3.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Underground nuclear tests cause strong seismic motion over large areas and provide an excellent opportunity to study pore pressure changes and liquefaction. The RIO BLANCO experiment offered a new opportunity to study in situ pressure changes. A small permanent stream, Fawn Creek, flows close to surface zero. The soils of this valley bottom were expected to be saturated and thus a suitable area for studying pore pressure changes under seismic loading. The experiment was reasonably successful. All acceleration measurements were successful and meaningful pore pressure measurements were obtained except at the four kilometer station. The dual pressure measurements demonstrated satisfactory consistency. In general, the sustained pore pressure increases were much lower than would be required to achieve liquefaction. No evidence was found of liquefaction in undisturbed soils in the post-shot search. The early transient pore pressure history correlates well with acceleration. This correlation is lost in the later portion of the records. The sustained pressure increases achieved were roughly proportional to both the peak particle velocities and the sum of the individual oscillation peaks of the strongest component of acceleration. The amplitudes and frequencies of the pore pressure histories suggest the soil permeabilities ranged from millidarcies to darcies. The transient response was less marked in the emplacement holes which dried and required irrigation. (CH)

5143 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 9, 564-572(Sep 1973).

Data are reported from routine radiation monitoring operations at the Feed Materials Production Center, Fernald, Ohio, from January through December 1971. Data are included on the gross α and β radioactivity, and content of thorium and uranium in particulates in surface air samples; the gross α and β radioactivity and content of uranium, ^{226}Ra, and ^{228}Ra in samples of water from the Miami River taken above and below the point of plant effluent discharge; and the content of uranium in soil samples resulting from deposition in stack effluents. (CH)

5144 MODELING OF ENVIRONMENTAL IMPACTS FOR ELECTRICAL ENERGY GENERATION IN WISCONSIN. Buehring, W. A.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 64-65(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Thermal Effluents

5145 (ORNL-TM-4267) COLD SHOCK: BIOLOGICAL IMPLICATIONS AND A METHOD FOR APPROXIMATING TRANSIENT ENVIRONMENTAL TEMPERATURES IN THE NEAR-FIELD REGION OF A THERMAL DISCHARGE. Pilati, D. A. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $3.25.

Biological data on the temperature preferences of fish indicate that, in general, they will be attracted to thermal discharges in the winter. This attraction to warmer temperatures increases their vulnerability to cold shock if the discharge heat source is discontinued. A scheme is proposed to predict the near-field thermal plume environmental temperatures during a power transient. This method can be applied to any jet discharge for which a steady-state model exists. The proposed transient model has been applied to an operating reactor. The predicted results illustrate how very rapidly the maximum temperatures decrease after an abrupt shutdown. This model can be employed to help assess the impact where cold shock may be a problem. Such predictions could also be the basis for restrictions on scheduled midwinter plant shutdowns. (auth)

5146 TWO-DIMENSIONAL DYNAMIC MODEL FOR COOLING TOWER PLUMES. Henninger, R. J. (Swiss Federal Inst., Wuerenlingen). Trans. Amer. Nucl. Soc.; 17: 65-66(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5147 COOLING TOWERS VS COOLING PONDS: A STATE-OF-THE-ART REVIEW. Kolflat, T. D.; Aschoff, A. F.; Baschiere, R. J. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 17: 405(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5148 ENVIRONMENTAL STUDIES DURING TWO DIFFERENT MODES OF ONCE-THROUGH CONDENSER COOLING. Eiler, H. O. (Industrial Bio-Test Labs., Inc., Northbrook, IL); Bernhard, H. F. Trans. Amer. Nucl. Soc.; 17: 405-407(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5149 DEVELOPMENT OF THERMAL MODELING FOR OCEAN DISCHARGES FROM A MULTIPORT DIFFUSER SYSTEM FOR SAN ONOFRE UNITS II AND III. Trent, D. S. (Battelle Pacific Northwest Labs., Richland, WA); Wiegman, S. A. Trans. Amer. Nucl. Soc.; 17: 407(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5150 ACTUAL AND PREDICTED THERMAL EFFECTS AT THE SAN ONOFRE NUCLEAR GENERATING STATION. Strachan, A. R. (Southern California Edison Co., Los Angeles). Trans. Amer. Nucl. Soc.; 17: 407-408(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Chemical Effluents

Refer also to abstracts 5102, 5115, 7363, 7381, 7433, and 7467.

5151 (COO-3236-6, pp 29-43) POTENTIAL FOR LEAD ISOTOPE STUDIES OF ENVIRONMENTAL POLLUTION IN INDUSTRIAL REGIONS. Kohman, T. P. 31 May 1973.

In nuclear chemistry and geochemistry research.

Some of the available information on and related to the isotopic composition of environmental lead is reviewed in the following areas: representation of lead isotopic composition; variations in isotopic composition of natural lead; lead isotopes in pollutant-lead sources; lead isotopes in pollutant lead; and potentialities in industrial regions. (DHM)

5152 (LBL-2162) MEASUREMENT OF ATMOSPHERIC SULFATE. Stein, H. P.; Hollowell, C. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 8p. (CONF-730666-1). Dep. NTIS $3.00.

From summer institute on energy: resources, utilization, and environmental impact; Berkeley, California, USA (25 Jun 1973).

The attribution of serious health consequences to atmospheric sulfate has stimulated interest in the analysis of particulate sulfate in ambient air. Sulfate particulate has also been implicated in problems involving visibility. Most urban atmospheric sulfur originates with sulfur dioxide (and much smaller quantities of sulfur trioxide) formed during the combustion of fossil fuels. The gaseous oxides of sulfur are converted in a relatively brief period of time (days) to particulate sulfate. Average sulfate concentrations in urban air are on the order of approximately $2 \times 10\ \mu g/m^3$. The high toxicity of sulfate may be due to the ability of the particulate to penetrate deeply into the lungs whereas the effects of gaseous sulfur dioxide are largely limited to the upper respiratory tract and eyes. Methods for collection of samples of sulfate particulate from ambient air and analysis of samples are described. Electron spectroscopy is the most sensitive technique for chemical analysis. (CH)

5153 (MHSMP-71-55) DISPOSAL OF WASTE OR EXCESS HIGH EXPLOSIVES. Progress Report, April-August 1971. Wichman, J.; Honea, F. I.; Bullerdick, W. A.; Mehroff, T. K. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1971. Contract DA-11-173 AMC-487(A). 80p. Dep. NTIS $6.00.

Progress is reported in studies aimed at the development of methods for the disposal of waste chemical explosives at AEC facilities in compliance with air quality standards set forth in the National Environmental Policy Act of 1969. It is pointed out that burning at selected open sites has been the accepted method of disposal. Sampling and analytical techniques were developed to obtain a quantitative estimate of products released to the air during combustion of various chemical explosives. The efficiency of various incinerators for the control of waste emissions during combustion was investigated. Other possible disposal methods considered include bacterial decomposition, chemical conversion and reclamation, and solvent extraction methods. The economic aspects of the various methods in relation to efficiency and added costs of transportation to treatment centers are discussed. (CH)

5154 (UCRL-74823) SIMULATION OF CHEMICAL KINETICS TRANSPORT IN THE STRATOSPHERE. Chang, J. S.; Hindmarsh, A. C.; Madsen, N. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1973. 18p. (CONF-731043-1). Dep. NTIS $3.00.

From symposium on stiff differentials system; Wildbad, F. R. Germany (4 Oct 1973).

The residence time of any material brought into the stratosphere is quite large (order of a year or more). With the advent of supersonic transports, the environmental impact of the engine exhaust has become a major concern. A principal concern has been the possible catalytic destruction of ozone (O_3) by nitric oxide (NO). Given a fleet of SST's the injected NO concentration could exceed many times the ambient. Furthermore, the enhanced NO concentrations will greatly increase the destruction of O_3 through the so-called NO_x catalytic cycle. It has been estimated that based on certain estimates of NO production rate from SST there could be a world wide reduction in ozone of from 3% to 50%. Atmospheric nuclear tests in the 1950's and early 1960's injected substantial amounts of NO_x into the stratosphere. It would follow that an examination of the ozone measurements of that period could possibly be used to estimate the significance of NO_x catalytic destruction of ozone in the stratosphere. In order to carry out such a study one must use a time dependent model and compute the time history of perturbations from 1956 to 1970 starting with the ambient atmosphere as determined by the model. By parameterizing the processes of production and injection of NO into the stratosphere during each atmospheric nuclear test, a highly discontinuous source function was constructed for use in prediction of changes in the yearly averaged ozone measurements. (CH)

5155 TOTAL HYDROCARBON ANALYZER FOR USE IN NUCLEAR SUBMARINES AND OTHER CLOSED ENVIRONMENTS. Eaton, H. G.; Umstead, M. E.; Smith, W. D. (Naval Research Lab., Washington, DC). J. Chromatogr. Sci.; 11: 275-278(May 1973).

A total hydrocarbon analyzer was developed to measure the total organic contaminant levels in the atmospheres of nuclear submarines. The detection of low levels of higher molecular weight organic substances is complicated by the presence of rather large quantities of methane and refrigerant gases normally found in submarine air. The total hydrocarbon analyzer is a specialized gas chromatograph utilizing compressed air as the carrier gas, a hydrogen flame ionization detector as its sensor, and employing backflush chromatography to obtain the total hydrocarbons. (auth)

5156 DEMINERALIZER REGENERANT WASTE REDUCTION STUDIES: POINT BEACH NUCLEAR PLANT. Frieling, D. D. (Wisconsin Electric Power Co., Milwaukee); Harris, C. H. Trans. Amer. Nucl. Soc.; 17: 411-413(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 5531, 6917, and 7200.

5157 (EANDC(E)-154(U), pp 25-27) CRITERIUM FOR TESTING THE QUALITY OF THE ν BAR MEASUREMENTS DONE WITH THE LARGE LIQUID SCINTILLATOR METHOD. Babinet, R.; Ribrag, M.; Signarbieux, C. (CEN de Saclay, France). Mar 1973.

From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

In a critical study of the liquid scintillator technique, a set of quantities which are independent of the efficiency were obtained. With the experimental setup in Saclay the first of these quantities (i.e. $R = (\nu^2) - (\nu)/(\nu)2$) was studied. The theoretical behavior is obtained to a good approximation; nevertheless, some systematic deviation could exist. A tentative explanation is made using a multiplicity-dependent efficiency. (auth)

General Detectors and Monitors

Refer also to abstracts 5385, 5689, 6476, 6751, 6869, 6870, 6913, 7116, 7251, 7255, 7271, 7275, and 7276.

5158 (BARC-689) FABRICATION AND TESTING APPARATUS FOR LID Si SURFACE BARRIER DETECTORS. Chaudhry, R. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

Apparatus has been set up for fabrication and testing of lithium-drifted silicon surface barrier detectors. The apparatus is described in detail. Relevant dimensions are given. Six detectors have been made. Performance of the detectors was within the range of specifications sold commercially for beta particles. The detectors were fabricated as a part of gaining experience and testing the apparatus. The apparatus has the characteristics for fabrication and testing of the detectors with the best specifications in a very efficient way. The work done so far and the experience gained is described. (auth)

5159 (BIPM-70-5) SOME PROBLEMS ASSOCIATED WITH THE $4\pi\beta-\gamma$ METHOD. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). 1970. 6p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The various corrections that must be considered in absolute $4\pi\beta-\gamma$ counting are discussed: background, dead times, and finite resolving time of the coincidence circuit. The results of a Monte-Carlo simulation are presented: transmission factor for true coincidences, ratio of the random coincidence and true coincidence rates as a function of the delay between the β and γ channels. (FR)

5160 (BIPM-70-8) CORRELATION OF A SERIES OF PULSES WITH DEAD TIMES. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). 1970. 9p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

If it is assumed that the original counting process was transformed in an x(t) function having two values +1 and −1, the changes in state of the secondary process occur at the moment of arrival of a pulse. The autocorrelation function is thus defined by the expectation $R(\delta)$ where the new variable δ is an artificially introduced delay. It is demonstrated that the rigorous expression for the probabilities of a stationary Poisson process, deformed by the presence of a dead time, lends itself to an exact determination of the $R(\delta)$ function, at least for small values of δ. (FR)

5161 (BIPM-71-4) FURTHER STUDIES ON RANDOM COINCIDENCE PAIRS. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). 1971. 8p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The importance of the method used to measure the resolution time is discussed for the case of random coincidences (in doubles or pairs). The resolution time is defined by the pulse width. In practice, directly obtained pulse durations (e.g. on a calibrated oscilloscope screen) are rarely measured. It is preferable to count random coincidences occurring between two independent series of pulses originating either from a radioactive source or from an oscillator. It is shown that the method involving two independent oscillators for measuring the resolution time of the coincidence circuit is the simplest and most rapid solution from the experimental point of view. The theoretical behavior of this system is also more easily described. (FR)

5162 (BIPM-110) SUMMARY OF FORMULAE FOR THE DEAD TIME DISTORTED POISSON DISTRIBUTION. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). Sep 1970. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

A short review of formulae for the dead time distorted Poisson distribution is put in advance of a detailed description of the methods by which they were obtained. (FR)

5163 (BIPM-112) INTERVAL DENSITIES FOR EXTENDED DEAD TIMES. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). Mar 1971. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Dead times of the extended type, where every incoming pulse is followed by a time interval in which no further registration is possible always produce larger losses than would result from the same dead times of the non-extended type. This is directly connected with their cumulative character, which can give rise to a very long period of total paralysis. This sort of dead time is imposed by the automatic pile-up suppression in window amplifiers for Ge−Li detectors. An attempt is made to arrive at an expression which enables the interval densities to be calculated after imposing an extended dead time. (FR)

5164 (CONF-731112-2) CORRELATION OF LOCAL TRAPPING WITH CRYSTAL DEFECTS BY DIRECT OBSERVATION OF ELECTRON LOSS IN A COAXIAL Ge(Li) DETECTOR. Strauss, M. G.; Sherman, I. S.; Bannon, R. W. (Argonne National Lab., Ill. (USA)). 1973. 12p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A propeller-shaped region of reduced full-energy-peak efficiency was observed on the face of a true coaxial Ge(Li) detector for use in a gamma camera. A similar pattern on the etch-pit photograph suggests that the propeller blades correspond to the 111 symmetry axes of the crystal. Spectra obtained when a 122 keV γ-ray beam was directed at this degraded region, show a low energy tail which is not present when the beam is directed at normal regions. Current pulses corresponding to γ-rays that interact in the propeller region have shapes that show deficiencies in the electron component. Thus, degraded crystal regions that are revealed by etch-pit distributions can be correlated to local detector performance by direct observation of trapping rather than only by inference from the presence of tails in the energy spectra. (auth)

5165 (CONF-731112-5) DIFFERENTIAL CURRENT PULSE PREAMPLIFIER FOR FISSION COUNTERS. De Lorenzo, J. T.; Clay, W. T.; Guerrant, G. C. (Oak Ridge National Lab., Tenn. (USA)). 1973. 12p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A current-pulse preamplifier with a differential input was developed for use with fission counters where there might be severe electrical interference. Tests with a vacuum tester coil show only a slight alteration of the normal noise background curve by the differential preamplifier but a great alteration by a single-ended preamplifier. Additionally, measurements show that if a differential current signal is obtained from the fission counter, the differential preamplifier can improve the signal-to-noise ratio (for electronic noise) nearly a factor of $\sqrt{2}$ over that of a single-ended unit. Tests of five prototypes built by a commercial manufacturer to RDT standards show good uniformity of performance, including gain stability, rise time, and linearity, well within the specified requirements. (auth)

5166 (DESY-DV-73/1) ISAAC: A SYSTEM FOR INTERACTIVE SCINTIGRAM ACQUISITION AND ANALYSIS BY MEANS OF A COMPUTER. Hoehne, K. H.; Lipps, H.; Pfeiffer, G.; Ebenritter, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 47p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

A system for the acquisition and analysis of scintigraphic data is described. It consists of a γ-camera and a computer PDP-8/e. The system is designed for utilization by non specially trained physicians. It is interactive, i.e., the result of every step of analysis appears on a CRT display with small delay (typically ≤ 1 sec). The structure of the system is described, its function is illustrated by several examples and the experience gained after one year's operation is discussed. (auth)

5167 (N-73-22398) SCINTILLATOR HANDBOOK WITH EMPHASIS ON CESIUM IODIDE. Tidd, J. L.; Dabbs, J. R.; Levine, N. (National Aeronautics and Space Administration,

Huntsville, Ala. (USA). George C. Marshall Space Flight Center). 13 Apr 1973. 92p. (NASA-TM-X-64741). NTIS.

A general background on scintillation detectors is given, and reference material on scintillators is provided. Particular attention is paid to the cesium iodide scintillators as used in the High Energy Astronomy Observatory (HEAO) experiments. It is intended especially for use by persons such as laboratory test personnel who need to obtain a working knowledge of these materials and their characteristics in a short time. (auth)

5168 (NP-19852, pp 76-79) METHOD OF MEASURING ALPHA DECAYS IN THE NANOSECOND RANGE. Nomura, T.; Hiruta, K.; Inamura, T.; Odera, M. Dec 1972.

5169 (NP-19852, pp 89-91) PARTICLE IDENTIFICATION STUDY FOR Z = 3 TO Z = 7 PARTICLES USING A POWER-LAW TYPE PARTICLE IDENTIFIER. Nakajima, S.; Kohno, I.; Yamane, I.; Yoshie, M.; Odera, M.; Kamitsubo, H. Dec 1972.

5170 (SAN-828-2) NUCLEAR INSTRUMENT LANDING SYSTEM. Phase II Interim Report Covering the Period June 1971–January 1973. Kaminskas, R. A. (TRW Systems Group, Redondo Beach, Calif. (USA)). 31 Jan 1973. Contract AT(04-3)-828. 88p. Dep. NTIS $5.45.

The analysis, design, construction, and field tests of a prototype Nuclear Instrument Landing System (NILS) are reported. NILS is designed as a short range guidance system for providing highly accurate aircraft position information during the last phases of descent and touchdown for completely automated landings in zero visibility weather. The NILS consists of ground and airborne equipment: the ground equipment is comprised of four beacons of modulated gamma beams and is permanently installed near the runway; the airborne equipment consists of a scintillation detector, four frequency detectors, and signal processing electronics. (WHK)

5171 PROPORTIONAL REGION IN GAS COUNTERS. Peskov, V.D. (Institute of Physical Problems, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 17: No. 12, 1992-1994 (June 1973).

It is usually assumed that high gas amplification coefficients cannot be obtained in counters with a nonquenching filling because of secondary processes. It is shown that the region of proportionality for these gases is limited by space charge. The limiting value of gas amplification at which space charge appears depends on the gas. The largest proportional region is obtained in gases with the lowest rate of rise in gas amplification as a function of voltage. (auth)

5172 PROBABILITY OF NON-DETECTION IN LIQUID SCINTILLATION COUNTING. Houtermans, H. (International Atomic Energy Agency, Vienna). Nucl. Instrum. Methods; 112: No. 1-2; 121-130(1973).

Possible errors inherent in the conventional extrapolation methods for the calibration of radionuclides by liquid scintillation counting are discussed. An alternate method has been proposed, which uses a discrimination threshold low enough to count nearly all the single-electron pulses. The fraction of lost disintegrations, which produce no signal at all, is calculated from the known energy spectrum of the nuclide. After-pulsing seems to be the main source of error for this method in its present form. (auth)

5173 RADIATION DETECTION THROUGH SOLID TRACT DETECTORS IN THE SCANNING MICROSCOPE. Paul, D. (Institut fuer Polymerenchemie, Berlin); Somogyi, G.; Haufe, G. Isotopenpraxis; 9: No. 4, 133-134(Apr 1973). (In German).

A cellulose acetate foil of 100 μm thickness was irradiated by a planar 3 MeV alpha source. After exposure, the foil was etched for one hour in a solution of 20 g NaOH, 16 g KOH, 4.5 g $KMnO_4$, and 90 g H_2O at 70°C. Subsequently, the foil was coated with a 20 nm thick film of gold and placed into the scanning electron microscope. The alpha tracks appeared as holes with a mean diameter of 5.5 μm. Both diameter and depth of the holes depended on the etching conditions. (HBG)

5174 ALPHA DETECTION BY SOLID-STATE TRACK DETECTORS IN ELECTRON MICROSCOPE. Paul, D. (Institut fuer Polymerenchemie, Teltow, Ger.). Isotopenpraxis; 9: No. 5, 176(May 1973). (In German).

The radiation source was an ultra-thin (0.15 μm) section of a resin containing radium-226. After being covered by a detector foil of cellulose acetate with 0.12 μm thickness, the section was exposed for 12 weeks, etched with sodium hydroxide, and contrasted with potassium permanganate which accumulated in the tracks, appearing as dark dots under the electron microscope. Depending on the energy of the alpha particles, the spots had diameters from 0.06 to 0.12 μm. (HBG)

5175 MEASUREMENT OF SCINTILLATION DECAY CURVES IN THE NANOSECOND REGION. Onishi, M. (Nagasaki Univ.); Niki, E. Jap. Anal.; 22: No. 9, 1126-1135(Sep 1973). (In Japanese).

An apparatus for the measurement of scinitillations using the sampling oscilloscope SAS 500 was set up. Cherenkov radiation was observed and the ability of the apparatus was studied with this instrumental impulse response. Crystal scintillations of trans-stilbene, anthracene, and NaI(Tl) were observed. The linear energy transfer (L.E.T.) effect of crystal scintillation of trans-stilbene was found when irradiated by α and β rays. When irradiated by β-rays, the ratio of intensity of fast component to that of slow component was larger than that by α-rays and the lifetimes of fast and slow components were smaller than those by α-rays. The initial spike originating from the two exiton annihilation was observed when the anthracene crystal was irradiated by α-rays. The liquid scintillation decay curves from the scintillator {toluene + 2,5-diphenyloxazole (PPO) 4 g/l} were observed and the lifetimes of two components were obtained. The lifetimes of the photofluorescences by ultraviolet excitation were measured with an FL 10 type phase fluorometer based on the phase shift method. The following results were studied. (1) Photo-fluorescent lifetimes of PPO solutions are shorter than the lifetimes of the liquid scintillator. Considerable processes besides the fluorescence process of PPO molecules exist in the case of liquid scintillation. (2) When the concentration of PPO is 4 g/l, reemissions of the fluorescence results from the absorption of the fluorescence or scintillation. The lifetimes become a little longer. (3) L.E.T. effect in the liquid scintillator exists as well as that of the trans-stilbene crystal. Different decay curves of liquid scintillators are delivered whether α or β-rays radiate scintillator. There is a good possibility of pulse shape discrimination using the liquid scintillator, the resolving time of which is smaller than that of trans-stilbene. (4) The influence of dissolved oxygen on the intensity and decay curves is studied, and the decrease of intensity of the slow component is pointed out. (5) The influence of the wavelength shifter 1,4-bis [2-(5-phenyloxazolyl)] benzene (POPOP) on the intensity and decay curves is tested. From the fact that the decay curve does not change much, the importance of the non-radiative energy transfer from PPO molecules to POPOP molecules is pointed out. (auth)

5176 STUDY AND CORRECTION OF GEOMETRICAL EFFICIENCY CURVE DISTORTIONS OF THE PINHOLE COLLIMATOR OF A GAMMA CAMERA. Depresseux, J. C. (Univ., Liege). Ann. Phys. Biol. Med.; 7: No. 1, 39-49(1973). (In French).

The pin-hole gamma camera, contrary to other scanning devices, gives collimator efficiency curves that are not parallel. The theoretical approach demonstrates a definite coefficient of geometrical efficiency distortion for each point of the crystal or of the displayed image. The geometrical distortion is of predominant importance compared to the detection inhomogeneity due to the image converter; it is equal to the product of two main factors: the penetration distortion (which depends on the detection spectrometry, the pin-hole aperture, and the nature of the absorbing material), and the sinusoidal distortion. The necessity of correcting the geometrical distortion is emphasized, and a correction method is presented using a multichannel memory and a correction factor matrix. (FR)

5177 NOISE EFFECT AFTER FILLING A COUNTER. Chrapan, J. (Komensky Univ., Bratislava). Fyz. Cas.; 22: No. 4, 219-222(1972).

The mechanism of noise effects resulting from the filling of a proportional or a Geiger-Mueller counter is described and an attempt to explain this effect is given. (Nucl. Sci. Abstr., Czech.)

5178 SIMPLE SYSTEM FOR LABELING GAMMA CAMERA IMAGES. Carroll, R. G. Nuclear Medicine Technical Note, DHEW Publication No. (FDA) 73-8023. Cincinnati; Bureau of Radiological Health (1972). 4p.

A simple system to provide positive identification of each individual frame of 35 mm or other film used to record gamma camera images is described. The information is printed over a phosphorescent background which is permanently mounted on a rigid slide. The slide moves in tracks which are fitted in the oscilloscope bezel such that the information is displayed flush with the cathode-ray tube face. The same optics which serve to focus and image the cathode-ray tube display also simultaneously image the information printed over the phosphorescent background. (auth)

5179 METHOD AND APPARATUS FOR OBTAINING THE RELATION BETWEEN THE CHANNELS RATIO AND THE EFFICIENCY IN A LIQUID SCINTILLATION STANDARD SAMPLE. Reunanen, M. A. (to Wallac Oy). US Patent 3,763,371. 2 Oct 1973. Priority date 3 Jun 1970, Finland. 4p.

A method and apparatus for obtaining the relation between the channels ratio and the counting efficiency of a liquid scintillation standard sample includes the transfer of a gaseous quencher from one vessel by means of an absorbent transfer medium to another vessel containing the liquid scintillation standard sample and plotting the light pulses obtained during the transfer. (Official Gazette)

5180 STUDY AND USES OF A CONTINUOUS DYNODE DETECTOR. Zironi Morelos, E. P. Mexico City; Universidad Nacional Autonoma de Mexico (1973). 93p. (In Spanish).

Thesis.

The detector bombarded with alpha particles from an ^{241}Am source functions normally at pressures less than 1×10^{-4} torr, and the optimum high voltage for operation in saturation is from 2900 to 3000 V; in the case of no saturation the applied voltage ought to be between 2400 and 2600 volts. When the bombardment is by electrons of energies up to the order of a keV, it is convenient to operate it at pressures of 10^{-6} torr and at high voltages greater than 3000 volts; to operate it in saturation the applied voltage will be from 3800 to 3900 V, but when it is necessary to exceed 4000 volts, it is advantageous to do it only for short periods of time and never at pressures below 1×10^{-3}, the maximum entrance currents for which there is no saturation by excess of counts are of the order of 5×10^3 electrons/mm^2/sec. Experiments that last longer than 10 hours cause fatigue in the detector making the decrease in the gain noticeable. In general terms, the detector does not work in a proportional manner but in the form of a counter. When the energy of the incident particles is less than 50 eV, it is possible to operate it as a proportional counter at the energy of the incident radiation. The graph of the total number of counts of the spectrum against the high voltage applied both for the electrons and for the alpha particles shows a plateau. The theory developed for the multiplier reproduces with good fidelity the experimental results except when the saturation begins to be noticed. But the phenomenon of saturation can be explained satisfactorily by the charge distributed at the end of the detector. The supposition that the coefficient of secondary emission from the cover of the detector is proportional to the energy of the primary electrons is valid since this does not exceed 20 eV. This value of the energy is found in the linear region of the coefficient of secondary emission for the impact of electrons for the majority of substances. The variation between the theoretical and experimental results for different energies of the primary ion is seen to be reflected in the different expressions by the loss of energy depending on the interval of applicability. When an expression for the restraining power includes all the energy intervals, then the comparison between theory and experiment can be more effective; on the contrary, the diverse intervals of energy will continue to be evaluated for the same phenomenon with theories that in principal are very different. (tr-auth)

5181 ANALYSIS OF GAMMA-CAMERA IMAGING DATA BY A SMALL DIGITAL COMPUTER. Dugdale, L. M.; Feiglin, D. H. (Alfred Hospital, Melbourne). Australas. Radiol.; 17: No. 2, 221-228(Jun 1973).

The use of a small digital computer system can substantially extend the diagnostic usefulness of a gamma-camera, particularly by allowing rapid manipulation of dynamic data. It also has a real place in complex functions such as flat-field correction and dual isotope substraction. (auth)

5182 RADIATION DETECTOR AND ITS MANUFACTURE. Meuleman, J. (to La Radiotechnique Compelec). French Patent 2,144,537. 2 Jul 1971. 12p. (In French).

A method is described for the manufacture of a semiconductor radiation detector which has a maximum useful volume, the largest possible entrance window, and good simple contacts. A detector-well type geometry is involved. The contact region with the walls and the region around the dishing are much larger and thicker than in the usual case. The periphery of the dishing is well defined; etching is not required. In this way leakage currents are reduced. A channeling is provided which reduces the diameter of the detector and separates the type II region into two intrinsic zones (the intermediate region). This channeling penetrates into the thick type I layer and is provided with a contact region on the thick layer and contact regions on each of the type II zones separated by the channeling. This type of structure can function as an assembly composed of two distinct very closely spaced detectors for anti-Compton spectrometry in addition to functioning as a classical or well-form detector. (FR)

5183 RADIATION DETECTOR AND ITS MANUFACTURE. Meuleman, J. (to La Radiotechnique Compelec). French Patent 2,144,538. 2 Jul 1971. 10p. (In French).

A method is described for the manufacture of a semiconductor radiation detector which has a maximum useful volume, the largest possible entrance window and good simple contacts. A detector-well type geometry is involved. The contact region with the walls and the region around the dishing are much larger and thicker than in the usual case. The periphery of the dishing is well defined; etching is not required. In this way leakage currents are reduced. In a first development, the thick layer has a smaller diameter than the body of the device and extends into the intermediate intrinsic region. In a second development, the diameter along part of the thickness of the layer is considerably reduced, the layer being implanted in the body of the detector in the direction perpendicular to the axis of the dishing. (FR)

5184 RADIATION DETECTOR AND ITS MANUFACTURE. Digoy, J. L. (to La Radiotechnique Compelec). French Patent 2,145,371. 9 Jul 1971. 13p. (In French).

A method for manufacturing a detector for ionizing radiations and high energy particles having an n-i-p structure is presented. The initial single crystal semiconductor is composed of p type (Ge, Si, or CdTe), the n type layer and the intrinsic layer containing lithium. The procedure employed enables a useful surface to be obtained for the entry window, which is as large as possible, and avoids the generation of parasitic currents around the periphery of the dishing. A detector having stable characteristics is formed. (FR)

5185 MINIATURIZED ANALYZER AND MAGNETIC RECORDER FOR FUNCTIONAL INVESTIGATIONS WITH RADIOISOTOPES IN NUCLEAR MEDICINE. Study and Construction of a Prototype. Assailly, J. (Hopital Necker-Enfants Malades, Paris); Chanard, J.; Bader, C. pp 416-420 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

A prototype apparatus was developed using integrated circuit techniques in conjunction with a high performance magnetic recorder. The technical performance of the different modules of this analysis unit is described. The independent functioning of the unit is ensured with Cd-Ni accumulators. The apparatus may be used with classical photomultipliers or with semiconductor detectors, and has applications in the field of functional exploration. The smallness and ease of operation of the apparatus makes it useful for emergency isotopic explorations. (FR)

5186 REDUCING THE SUSCEPTIBILITY TO INTERFERENCE OF NUCLEAR PULSE COUNTING ASSEMBLIES. Buisson, J. (CEN, Saclay, France). pp 503-512 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In neutron monitoring systems the measurement assemblies most susceptible to interference are frequently those operating in a pulsed regime. This paper analyses the mechanism of interference and shows that, whatever the origin of the interference (mains supply, radiation, differences in ground potential), the resultant phenomenon is always the same: the circulation of a current in the equipment screening. This current is the basic cause of measurement interference. The mechanism of action of this current, in relation to plugs, electronic component screening and cable screening, is considered. The concept of transfer impedance (characterizing the immunity of cables to interference) is explained. Results are given for different cables, in particular a new cable with mu-metal screening recently developed by the CEA. (auth)

5187 DESIGN AND USE OF HIGH PERFORMANCE SCREENED CABLES FOR REDUCING ELECTRICAL INTERFERENCE EFFECTS IN NEUTRON FLUX MEASURING CHANNELS. Wilson, I.; Fowler, E. P. (Atomic Energy Establishment, Winfrith, Eng.). pp 513-525 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The levels of interfering signals which can be tolerated by pulse counting, mean dc and Campbell type neutron flux channels are described. In the light of current knowledge of the coupling mechanisms which are likely to occur between electrical plant and instrumentation it is concluded that the screening performance of instrument cables should not fall below levels which can be calculated for specific installations. Designs of cables are described which enable the necessary degree of screening to be achieved and

which confer other advantages, such as a greater degree of freedom in choosing locations for the electronic equipment. If an adequate degree of screening is to be achieved in practice, particularly when a combination of mineral insulated and braided cables is employed, it is essential that care be taken in the choice and design of connectors and electronics. The interpretation of the relevant design factors is discussed. (auth)

5188 WIDE-RANGE NEUTRON MEASUREMENT ASSEMBLY. Plaige, Y. (CEN, Saclay, France); Mai, Vuong Quan. pp 711-717 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The neutron flux measurements with pulsed and fluctuation methods use the same detector types: fission chamber. But their ranges of measurements are complementary: pulsed method for low-flux, fluctuation method for high-flux. By associating these two types of measurements both of which have an excellent discrimination between neutron gamma, one can realize a wide range of neutron measurement assembly (10 decades with an overlap range of two decades) using only one detector in a fixed position. This instrumentation provides a flux measurement in logarithmic scale and a period measurement for the whole range of measurements and, also, a current measurement for high-level safety. This instrumentation has been frequently experienced in the reactor and it is at the industrialization stage. (auth)

5189 LONG-LIFE ION CHAMBERS AND BF_3 COUNTERS FOR REACTOR INSTRUMENTATION AND THE IN-SITU TESTING OF NONRETRACTABLE PULSE FISSION COUNTERS. Goodings, A.; McMinn, K. W.; Wilson, I (Atomic Energy Establishment, Winfrith, Eng.). pp 719-732 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

This paper deals with recent developments in the design and in-situ testing of long-life neutron detectors suitable for use in low power range pulse counting channels. It is shown that in many applications it is no longer necessary to provide equipment for retracting such detectors when the reactor is at full power, with consequent economies and operational advantages. The limitations of conventional copper-bodied BF_3-filled neutron counters are discussed and the advantages of the alternative aluminium devices are put forward. Work is described which has led to the development of instruments with an unpolarized irradiation life in excess of 10^{18} n/cm^{-2}. These counters have low activation levels and can be used for reactor startup purposes tens of minutes after shutdown from up to 10^{11} n/cm^{-2}/s^{-1}. Temperature tests have shown them capable of working effectively for extended periods at 80 to 100°C and one version has been designed to be equivalent in size and sensitivity to the copper-bodied counters used in Magnox reactor and other instrumentation systems. Pulse fission counters may also be used for startup channels and in many situations it is convenient to locate them in fixed positions. Some results which demonstrate the lives of counters in this type of situation are given. It is noted that one should, when at full power, have some simple means of checking that the measuring channel, including the neutron detector, is capable of operating correctly immediately after a rapid shutdown. Faults which can develop in the detector and the associated signal processing electronics are analyzed and the conclusion drawn that most likely failures can be detected by exploiting the properties of fission pulse pile-up noise. Checking routines which can be employed in a practical situation are described and the essential electronic equipment parameters necessary to implement them are outlined. (auth)

5190 NEUTRON FLUX MEASUREMENTS IN REACTORS WITH HIGH TEMPERATURE FISSION CHAMBERS AND COBALT COLLECTRONS. Bacconnet, E.; Dauphin, G.; Duchene, J.; Verdant, R. (CEN, Saclay, France). pp 769-782 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Twenty cobalt collectrons were tested in reactors and operated satisfactorily. Three of them integrated 5×10^{21} n/cm^{-2}. The sensitivity was 0.7×10^{-22} and 1.8×10^{-22} A/(n/cm^{-2}/s^{-1}) per cm for emitters 1 and 2 mm in diameter respectively. The response was instantaneous. The noise components were studied, in particular, and must be taken into account separately by the operator. It has been shown that the noise of a collectron cannot be represented by a unique value. The use of collectrons is analyzed, and their value for recording macroscopic flux variations and for power reactor safety is indicated. The results of prolonged testing of miniature fission chambers in pulsed operation up to 600°C are described. A parallel study of the behavior of chambers containing a gaseous mixture giving a rapid response and of chambers in which the filler gas allows only a relatively slow response is reported. The present results are based on 11740 h of operation including, for certain chambers, 5000 h at 500°C and 3340 h at 600°C. (auth)

5191 DEVELOPMENT AND IN-CORE APPLICATION OF SELF-POWERED NEUTRON DETECTORS. Gebureck, P.; Hofmann, W.; Jaschik, W.; Seifritz, W.; Stegemann, D. (Technische Univ., Hanover). pp 783-802 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Development work for self-powered neutron (SPN) detectors and results of in-core applications are described. The primary aim of the research and development work is directed towards SPN detectors, which follow changes in neutron flux promptly. This offers the advantage: (a) to use these in-core detectors within the safety and control system; (b) to apply the sensors at the same time for reactor noise detection as a diagnostic tool for an early measurement system of reactor malfunctions. The in-core application is a long-term program to test and to prove the reliability of these sensors in present-day power reactors. Besides the well-known emitter material cobalt, a number of promising new emitter materials have also been investigated. Furthermore, a comparison has been made between SPN detectors having wires as emitters and such constructions using foil emitters. More basic experiments concern neutron- and γ-sensitivity measurements with prototype detectors, which have been constructed for this special purpose to find an optimum design regarding the ratio of neutron-to-gamma efficiency. The experimental results were compared with theoretical calculations. The detector dimensions investigated range from 25 mm in diam. and 90 mm in length (prototype detector) to 1.6 mm in diam. and 130 mm in length. The SPN detectors developed and built have been and are being tested in high flux materials test reactors as well as in a running boiling-water reactor. Results from these test series and also from noise measurements are presented. The results include a comparison between SPN detectors and other in-core sensors, such as fission chambers and ^{235}U-coated thermocouples. (auth)

5192 ALPHA-PARTICLE ASSAY USING LIQUID SCINTILLATION AND PULSE-SHAPE DISCRIMINATION. McKlveen, J. W.; Johnson, W. R. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 17: 88(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5193 PERSONNEL MONITORING SYSTEM FOR SPECIFIC INTERNAL RADIOACTIVE CONTAMINATION. Hearn, R. A. Jr.; Walker, D. M. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 17: 98(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5194 COMPARISON OF RADIATION DETECTION SYSTEMS FOR NEUTRON ACTIVATION ANALYSIS OF Hg IN DENTAL RESEARCH. Synder, K. R.; Ellis, W. H. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 17: 98-99(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5195 PORTABLE, HIGH-SENSITIVITY RADIATION DETECTOR FOR SEARCH APPLICATIONS. Henry, C. N.; Chambers, W. H.; Worth, G. M. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 114(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5196 SOLID TRANSURANIC WASTE ASSAY AT THE 10 nCi/g LEVEL. Umbarger, C. J.; Forster, R. A. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 332-333(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5197 COMPARISON OF GAMMA IRRADIATION PERFORMANCE OF TWO NEUTRON FISSION COUNTERS HAVING DIFFERENT ELECTRODE SPACINGS. Philipp, L. D.; Wood, M. R. (Westinghouse Electric Co., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 387-388(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiation Dosimeters

Refer also to abstracts 6749, 6750, 6753, 6953–6956, and 6958.

5198 (CONF-730968-1) LET RESPONSE OF SOLID-STATE DETECTORS. A Review. Becker, K. (Oak Ridge National Lab., Tenn. (USA)). 1973. 22p. Dep. NTIS $3.25.

From fourth international symposium on microdosimetry; Verbania, Italy (27 Sep 1973).

It is shown in a review of the LET response of various solid-state dosimeters such as TLD, RPL, TSEE, and photographic film that most of them exhibit (as predicted by the model of trap saturation by low-energy delta rays in a cylindrical zone around particle tracks) a more or less pronounced decrease in sensitivity with increasing LET. The relationship between trap density (low LET saturation dose) and relative high LET (alpha particle) efficiency as well as some changes in the TL or TSEE curves can also be explained by this model. There are, however, apparently also some qualitative differences between the effects of low LET and high LET radiation, which indicate semi-permanent structural changes along high-LET particle tracks. It is concluded that both trap saturation and structural damage contribute to varying degrees, depending on lattice characteristics and the nature of the observed effect, to the detector response. (auth)

5199 (CONF-731101-34) PREPARATION AND CHARACTERIZATION OF NEUTRON DOSIMETER MATERIALS. Kobisk, E. H.; Adair, H. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 37p. Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Neutron dosimeters of ^{6}Li, ^{10}B, ^{45}Sc, ^{232}Th, ^{235}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, and ^{241}Pu encapsulated in high-purity V (≤10 ppM Ta) have been prepared. Gamma spectra of ^{234}U, ^{238}U, ^{239}Pu, and ^{237}Np dosimeters are given; gamma counting before and after welding indicated no loss of U during capsule welding. Results of analyses of archive samples are given. Thin films of $^{235}UO_2$ and $^{239}PuO_2$ were deposited for reaction rate and neutron cross section measurements; alpha and gamma counting was used to measure the amount deposited. The preparation of homogeneous alloys by levitation melting is described briefly with V–1.3% Au as an example. (DLC)

5200 (COO-1671-48) DOSIMETRIC IMPLICATIONS OF THE 1 HIT DETECTOR. Katz, R. (Nebraska Univ., Lincoln (USA)). 1973. 13p. (CONF-730345-2). Dep. NTIS $3.00.

From regional conference on radiation protection; Jerusalem, Israel (6 Mar 1973).

The properties of the 1-hit detector are specified from knowledge of two parameters, a characteristic dose, giving the response to gamma-rays, and a characteristic size, needed for the response to heavy ions, principally at low LET. The general characteristics of the response of the detector can be related to a point-target model through 2 parameteric combinations, $\kappa = E_0 a_0^2/2 \times 10^{-1}$, and $\lambda = \tau/a_0 \simeq 10^{-2}\beta^2/a_0$, where E_0 is the characteristic dose, a_0 the characteristic size, β is the relative ion speed, and τ the greatest radial penetration of delta rays. For large values of κ and λ the response of these detectors may be calculated in the point target approximation, illustrating once again that the size of the sensitive element has little to do with the response at high LET. These detectors characteristically decline in radiosensitivity with an increase in z^2/β^2 of the bombarding particle, have a radiosensitivity which is neither linear nor single valued in z^2/β^2 (or LET), and have an "RBE" which is always less than 1 for heavy ions. The RBE diminishes regularly with an increase in detector sensitivity. Many detectors are members of the class of 1-hit detectors or are at least candidates for inclusion in this class. Included are emulsion, scintillators, thermo and photo luminescent dosimeters, TSEE, the Fricke dosimeter, radical production, enzyme and virus inactivation, darkening of dye cyanide films, and optical rotation in arabinose solutions. Since, on clear theoretical grounds, these detectors cannot have an RBE which is greater than 1, which must increase with increasing E_0 and increasing particle speed, they may have a significant role to play in standardizing neutron and energetic particle dosimetry. (auth)

5201 (ORNL-TM-4387) 1972 INTERCOMPARISON OF NUCLEAR ACCIDENT DOSIMETRY SYSTEMS AT THE OAK RIDGE NATIONAL LABORATORY. Poston, J. W.; Haywood, F. F. (Oak Ridge National Lab., Tenn. (USA)). Jul 1972. Contract W-7405-eng-26. 90p. Dep. NTIS $6.50.

The ninth in the continuing series of intercomparison studies of accident monitoring systems was held from July 17 to 28, 1972. The ORNL Health Physics Research Reactor, operated in the pulse mode, served as the fission source. Three different spectra were used to simulate nuclear accidents. Detectors used as area monitors as well as personnel monitoring badges were intercompared under a set of standard conditions. Various threshold and TSEE detectors were compared for neutron dosimetry, and RPL, film, TLD, and TSEE detectors were compared for gamma dosimetry. Results of the experiment indicated that reported values of fast neutron dose were within ±30 percent for all pulses, while gamma-ray measurements were within ±26 percent at one standard deviation. (auth)

5202 (UCRL-74796) MOSFET DETECTOR EVALUATION. Ciarlo, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1973. 7p. (CONF-731112-3). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Metal-oxide-semiconductor devices have been evaluated as low-energy (250 eV to 50 keV) x-ray dosimeters. They can be used to measure dosages as low as 1 rad (SiO_2) to as high as 10^5 rad (SiO_2). Their small size and basic simplicity make it possible to form arrays of dosimeters for x-ray imaging. When compared to thermoluminescent dosimeters (TLD's), photographic film, and thermopiles, MOSFET dosimeters offer distinct advantages in terms of their small size, their sensitivity to photon energies below 10 keV, and their adaptability to an electrical readout system. (auth)

5203 RADIATION INDUCED OXIDATION OF THE MALACHITE GREEN LEUCOBASE IN ACETONE SOLUTION IN THE PRESENCE OF CALCIUM CHLORIDE. Possible Use As Dosimeter. Dejehet, F. G.; De Kimpe, A. G.; Apers, D. J. (Univ., Louvain, Belgium). Radiochem. Radioanal. Lett.; 15: No. 3, 177-186(20 Oct 1973).

γ-Radiation induced oxidation of the leucobase of malachite green, in acetone solution (10^{-2}M) and in the presence of calcium chloride (0.7 10^{-3}M), shows a proportionality of dye formation with dose at least in the range of 1.5 to 25 krads. The G factor is estimated as 1.5/100 eV and the system is applicable as a chemical radiation dosimeter. (auth)

5204 PHYSICAL MEASUREMENTS OF MEDICAL ELECTRON BEAMS: A REVIEW. McEwan, A. C. (National Radiation Lab., Christchurch, New Zealand). Australas. Radiol.; 17: No. 3, 328-339(Sep 1973).

A description is given of the machines which are most commonly used for high energy radiation therapy. Methods of energy measurement include magnetic deflection, scintillation pulse height analysis, Cherenkov emission threshold, nuclear reaction thresholds, and range measurements. The effect of scattering on the electron energy spectra is described. Methods of electron dosimetry such as calorimetry, cavity ionization, chemical dosemeters, thermoluminescent dosemeters, and film dosemeters are reviewed. (AT)

5205 STUDY ON THERMALLY STIMULATED EXOELECTRON EMISSION AS A BASIS FOR HIGH DOSE MEASUREMENT AND ITS RELATION TO THERMALLY STIMULATED CURRENT. Okabe, S.; Tsumori, K.; Ogita, K. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 55-58(1972).

Thermally stimulated exoelectron emission (TSEE) was studied in order to utilize this for measuring high doses with good reproducibility. Using $CaSO_4$, a slight trend of saturation was found at 10^6 R in the relation between TSE and irradiated dose. Fading effect of TSEE was rather small compared with the cases of other papers but gas pressure effect was rather large. To make clear the mechanism of TSEE, relations among TSE, thermally stimulated current and thermally stimulated light were studied for different crystalographic orientations of samples. Peak positions of the latter two phenomena correspond to those of TSE to some extent. Samples used were CaF_2, LiF, rock crystal and sapphire. (auth)

5206 COMPARATIVE STUDY OF THE BURLIN AND ALMOND CAVITY THEORIES FOR A LITHIUM FLUORIDE CAVITY IN A POLYSTYRENE MEDIUM FOR ELECTRON BEAMS USED IN RADIATION THERAPY. Paliwal, B. R. Houston, TX; Univ. of Texas (1973). 144p. University Microfilms Order No. 73-27,077.

Thesis (Ph. D.).

There exist two theories by which the response to electrons of a radiation sensitive detector may be evaluated. Though both the Burlin theory and the Almond theory are generalizations of the Spencer and Attix cavity theory, each of these theories predicts a significantly different response to electrons relative to cobalt gamma rays in the case of a lithium fluoride cavity embedded in a polystyrene medium. Several authors have experimentally investigated the response of lithium fluoride to high energy electrons, and their measurements also show an apparent inconsistency. Whereas some authors find a relative decrease in response on the order of 9 to 12%, the others fail to find any change. A theoretical investigation of the Burlin and the Almond theories was carried out. In both of the theories it is the weighting factor d that extends the Spencer–Attix theory to all cavity sizes. This weighting factor in itself is a function of the mass absorption coefficient, β, of the cavity for a given maximum energy of electron, and the cavity dimensions expressed in terms of the average path length of electrons across the cavity. The transmission of electrons through solid lithium fluoride crystals was measured using beta emitters, and values of the mass absorption coefficient were evaluated. The values of β were also evaluated using Evans' relation for Al and the range-energy data of Berger and Seltzer for both LiF and Al. A study of the criticality of the choice of the parameters beta and d showed that the outcome of the Almond theory was not significantly altered whatever the method employed to obtain beta and d. On the other hand, the Burlin theory showed a slight dependence on these parameters. Theoretical calculations of the response of a solid LiF crystal embedded in a polystyrene medium to electrons and ^{60}Co gamma rays were carried out for both the Almond and the Burlin theories. The two theories showed a very good agreement for a small cavity size ($g = 0.014$ gm/cm^2, cavity diameter ≈160 microns) and no significant change in response to electrons relative to ^{60}Co gamma rays was predicted. However, for a large cavity ($g = 0.7$ gm/cm^2; cavity dimensions $1 \times 1 \times .19$ cm) the Almond theory predicted a decrease in response to electrons relative to ^{60}Co gamma rays on the order of 11 percent. The Burlin theory, under similar conditions, predicted a decrease in response of about 91% to 17% for a corresponding energy range of 1 MeV to 50 MeV, respectively. Measurements of the response per rad to electrons of 7 MeV to 28 MeV of large LiF solid crystals ($g = 0.7$ gm/cm^2; dimensions $1 \times 1 \times .19$ cm) embedded in a polystyrene phantom were carried out and compared to the response per rad of ^{60}Co gamma rays. The relative average decrease in response of 12.2% was found to be in agreement with the average value of 10.3% predicted by the Almond theory, within an experimental error of ±2%. The Burlin theory however, predicts a decrease in response of 67% to 23% under similar conditions of measurement. Thus it appears that the Almond theory not only predicts the experimental outcome, but also explains the inconsistencies in the experimental data of the various authors. It is therefore concluded that the decrease in response of LiF dosimeters to electron beams is a cavity phenomenon and the dosimeter configuration must be taken into consideration in order to make appropriate use of the dosimeter. (Diss. Abstr. Int., B)

5207 CHARACTERISTICS OF THERMOLUMINESCENCE DOSIMETER (Mg_2SiO_4 AND MgB_4O_7) IN RADIOTHERAPY. Watanabe, Y.; Okumura, H.; Sugie, Y.; Hayakawa, N.; Tomiyoshi, T. (Nagoya Univ., Japan). Nippon Hoshasen Gijutsu Gakkai Zasshi; 29: No. 2, 179-183(Jul 1973). (In Japanese).

Research concerning the characteristics of TLD Mg_2SiO_4 (MSO) and MgB_4O_7 (MBO) in radiotherapy is reported. There is no dependence of fading within 3 hours and no directional dependence of incident radiation. Radiation energy dependence is the most remarkable at 30 to 40 keV for x-rays. On the other hand, there is no energy dependence at high energy for radiation such as cobalt 60 γ-rays. MBO is better than MSO in exposure dose dependence, and MSO has a poor dose dependence at over 100 R. There is no dependence of depth dose rate for either TLD. MBO has better characteristics than MSO for high energy radiation such as cobalt 60 γ-rays. (auth)

5208 LOW-TEMPERATURE RESPONSE OF LiF-TEFLON DOSIMETERS. Milvy, P. (New York Univ.); Orton, C. G.; Seibert, J.; Kaufman, L. A. Radiat. Res.; 56: No. 2, 232-237 (Nov 1973).

Lithium fluoride-Teflon microrods irradiated at 77°K show a 20% decrease in sensitivity compared to samples irradiated at room temperature. Measurements were made at ^{60}Co and 50 kVp energies in both the linear and supralinear response regions. The observed decrease in sensitivity is attributed to a decrease in the number of electrons trapped in levels contributing to the main glow curve peak. A mechanism of competing trapping states present only at low temperatures can explain the general features of the data. Some electrons, normally trapped in the main glow curve energy levels, are instead bound to lower temperature competing traps. These do not contribute to the integrated thermoluminescent intensity because of rapid fading at room temperature. (auth)

5209 THERMOLUMINESCENCE DOSIMETRY (TLD). Stolz, W.; Rochelt, S. (VEB RFT Messelektronik, Dresden). Isotopenpraxis; 9: No. 7, 238-247(Jul 1973). (In German).

For the time interval from 1968 to 1972, the advances in dosimetry of ionizing radiation with TLD phosphors are reviewed. Only practical problems of thermoluminescence are covered; kinetic model considerations are excluded. The discussion includes general properties of lithium fluoride, calcium fluoride, lithium borate, calcium sulfate, and others. The review covers heating, light transfer, and light measurement. Also included is the practical application of such dosimeters in personnel protection, monitoring of environment, and clinical radiology. (214 references) (HBG)

5210 MAXIMUM DOSE RATES MEASURED ABOARD THE SKYLAB COMMAND MODULE. Grimm, A. (AFWL/DYT, Kirtland AFB, NM); Janni, J.; Schneider, M. Trans. Amer. Nucl. Soc.; 17: 9-10(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 5246, 5720, and 7025.

5211 (AERE-R-7556) BRUCE: BUFFER REGISTER UNDER COMPUTER EDICT. Morris, D. V. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

The collection of data from neutron time-of-flight experiments is greatly speeded up by using a multishot analyzer system. Such a system using a buffer store, and interfaced to a PDP $^{11}/_{45}$ computer is described. Examples are given of the enhanced count rates achieved. (auth)

5212 (AREAEE-161) SINGLE CRYSTAL Ge(Li) GAMMA-RAY SPECTROMETER. Eissa, E. A.; Abu-Zeid, H. M.; El-Kady, A. A.; Rofail, N. B.; Tolchenkov, D.; Hamouda, I. (Atomic Energy Commission, Cairo (Egypt)). 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

A true coaxial Ge(Li) detector of 30 cm^3 sensitive volume and its associated electronics were set up as a single crystal gamma-ray spectrometer. The characteristics of the spectrometer were investigated for optimum performance using ^{241}Am, ^{57}Co, ^{137}Cs, ^{22}Na, ^{54}Mn, ^{60}Co, ^{88}Y and ^{232}Th standard gamma-ray sources. The best resolution was found on biasing the Ge(Li) detector with 1300 volts. Counting rates higher than 400 pulses/sec result in shifting the position of the spectrum. The use of Baseline/Pileup Rejector (indicated as R/R) allows for higher counting rates up to 2000 pulses, with a negligible shift in the position of the gamma spectrum and without any serious changes in the resolution. Time constants for the spectroscopy amplifier were found to be optimum at 1 μ sec for both differentiation and integration times. It was found necessary to set the R/R shaping time constant at a value which is always equal to the spectroscopy amplifier time constants. The FWHM at the 1173 keV gamma line of ^{60}Co was found to be 4.7 keV. Noises due to electronics contribute basically with 1.9 keV to the FWHM of the gamma-lines. The resolution and photopeak efficiency dependence on the gamma-ray energy were investigated. The gamma-ray spectra from various radioactive sources are shown. (auth)

5213 (AREAEE-167) PROPOSAL FOR NONDESTRUCTIVE ANALYSIS OF GEOLOGICAL SAMPLES BY GAMMA-RAY CASCADE MEASUREMENTS. Eissa, E. A. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

A proposal for setting two Ge(Li) detectors in an external pulse summing technique, for measuring gamma-ray cascades following thermal neutron capture in nuclei is offered. The possibility of applying the technique to nondestructive elemental analysis of geological samples is discussed. (auth)

5214 (CEA-N-1655) GAMMA SPECTRA PROCESSING FOR THE GERMAINE AIR LOOP AND IRENE WATER LOOP. Le Meur, R.; Bechemilh, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 2 May 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

An off-line or in-line processing of the spectra may be envisaged. The off-line processing requires three steps: decoding,

analysis and identification. The analysis with the ANASPE code includes an automatic search of the peaks; each peak is fitted with a Gaussian curve and a precise calculation of the peak abscissa, energy resolution and surface is possible. After an energy calibration, the abscissa and resolution can be given in keV. The identification of the nuclides in the sample, using the ACTIF code includes the calculation of the activity from the experimental data and the intensities predicted for the various γ lines. The on-line processing does not include the automatic search of the peaks, but a choice of energy windows is required for analysis. A code, derived from the PLURIMAT code, gives the peak abscissa resolution and surface. (FR)

5215 (JINR-P6-7308) HIGH PRECISION MEASUREMENTS OF THE ENERGIES AND THE INTENSITY OF THE γ-RAYS WITH Ge(Li)-DETECTORS. Aleksandrov, V. S.; Vylov, Ts.; Muminov, T. M.; Osipenko, B. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A spectroscopic system with Ge(Li)-detectors was considered: optimum working conditions were selected and a method for the energy and the intensity determination of the γ-rays worked out. Under the conditions of the investigation the accuracy of the energy and the intensity determination which can be achieved is 10 to 30 eV and ±2%, respectively. (auth)

5216 (N-73-20484) ELECTRON-PROTON SPECTROMETER QUALITY ASSURANCE PROCEDURES FOR EQUIPMENT AND PARTS. Gleeson, P. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). 1972. 8p. (NASA-CR-128853; EPS-434). NTIS.

Quality control procedures are established for personnel who are concerned with receiving, storage, transfer, inspection, and use of flight or mission related hardware for the electron/proton spectrometer (EPS) program. While general guidelines, designed to cover all situations, exist, this document provides guidelines and procedures specifically designed to supplement the quality assurance activity on the EPS Program. It is the purpose of this document to insure that all equipment, parts and other hardware received and/or used in the EPS program meet or surpass the standards and requirements established by cognizant authorities. (auth)

5217 (N-73-20485) SAFETY ASSESSMENT FOR EPS ELECTRON-PROTON SPECTROMETER. Gleeson, P. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). Aug 1971. Contract NAS9-11373. 9p. (NASA-CR-128851; EPS-425). NTIS.

A safety analysis was conducted to identify the efforts required to assure relatively hazard free operation of the EPS and to meet the safety requirements of the program. Safety engineering criteria, principles, and techniques in applicable disciplines are stressed in the performance of the system and subsystem studies; in test planning; in the design, development, test, evaluation, and checkout of the equipment; and the operating procedures for the EPS program. (auth)

5218 (N-73-20486) END-TO-END TEST OF THE ELECTRON-PROTON SPECTROMETER. Cash, B. L. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). 1972. 46p. (NASA-CR-128852; EPS-955). NTIS.

A series of end-to-end tests were performed to demonstrate the proper functioning of the complete Electron-Proton Spectrometer (EPS). The purpose of the tests was to provide experimental verification of the design and to provide a complete functional performance check of the instrument from the excitation of the sensors to and including the data processor and equipment test set. Each of the channels of the EPS was exposed to a calibrated beam of energetic particles, and counts were accumulated for a predetermined period of time for each of several energies. The counts were related to the known flux of particles to give a monodirectional response function for each channel. The measured response function of the test unit was compared to the response function determined for the calibration sensors from the data taken from the calibration program. (auth)

5219 (N-73-20493) CALIBRATION OF THE ELECTRON-PROTON SPECTROMETER. Cash, B. L. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). 1972. Contract NAS9-11373. 58p. (NASA-CR-128850; EPS-956). NTIS.

The principal function of the sensor used in the electron-proton spectrometer is to provide a signal which can be used to determine the energy and indicate the type of an incident particle. Two techniques are employed to resolve the particle intensity in different energy regions. The first employs a moderator surrounding each detector to provide a nominal lower limit to the energy of a particle which can be detected. The second technique utilizes a pulse height discriminator to identify those particles entering a detector whose energy is sufficiently high that it exceeds the discriminator level if the particle is stopped in the detector, or sufficiently low that the ionization rate causes the discrimination level to be exceeded for paths through the detector shorter than the particle range. (auth)

5220 (NP-19852, pp 87-88) DUAL Ge(Li) GAMMA-RAY SPECTROMETER FOR NUCLEAR STUDY. Okano, M.; Tendow, Y.; Katou, T.; Izumo, K.; Kumagai, H.; Hamada, T. Dec 1972.

5221 (RFP-2128) ALPHA PULSE HEIGHT ANALYSIS OF 32 SAMPLES SIMULTANEOUSLY USING A MINICOMPUTER. Allen, I. B.; West, J. R. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1973. 13p. (CONF-730960-1). Dep. NTIS $3.00.

From 19th annual analytical chemistry conference; Jackson Hole, Wyoming, USA (3 Sep 1973).

An alpha spectroscopy system for analysis of environmental samples at Rocky Flats is described. The system consists of 16 silicon detectors and associated electronics (preamplifiers, amplifiers, multiplier/router, analog-to-digital converter, pulse-height analyzer) for input in a NOVA 1200 minicomputer with 24 K, 16 bit memory. Software is briefly discussed. (WHK)

5222 (USIP-73-4) EFFECTS OF DEVIATIONS FROM CYLINDRICAL SYMMETRY IN LENS SPECTROMETERS USED FOR ELECTRON-GAMMA DIRECTIONAL CORRELATION STUDIES. Holmberg, L.; de Sousa, N.; Pettersson, B-G.; Gerholm, T. R. (Stockholm Univ. (Sweden). Fysiska Institutionen). Mar 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The influence on electron–gamma directional correlations caused by deviations from cylindrical symmetry in a magnetic lens spectrometer is investigated. It is found that the asymmetries must be large in order to appreciably affect the directional correlation result. Furthermore, when present, such asymmetries are in general detected by comparing the electron–gamma coincidence rate at the relative angles of 135° and 225°. (auth)

5223 INVESTIGATION OF X-RAY TRANSITION RADIATION IN FOAM PLASTIC. Alikhanyan, A. I.; Belyakov, E. S.; Lorikyan, M. P.; Markaryan, K. Zh.; Shikhlyarov, K. K. Zh. Eksp. Teor. Fiz.; 65: No. 4, 1330-1336(Oct 1973). (In Russian).

Electron transition radiation in foam plastic targets of various thickness and density is investigated. It is shown that the radiation intensity increases with growth of electron energy and also with growth of the plastic thickness and density, mainly at the expense of soft photons (5 to 25 keV). (auth)

5224 TRANSITION RADIATION DETECTION OF PARTICLES. Lorikyan, M. P. Zh. Eksp. Teor. Fiz.; 65: No. 4, 1327-1329(Oct 1973). (In Russian).

The angular distribution of transition radiation photons produced in a foam plastic radiator is studied. Some possibilities of detecting particles by their transition radiation are discussed. (auth)

5225 COMPUTER ASSISTED GAMMA SPECTROMETRY AT THE ISPRA JOINT RESEARCH CENTRE. Di Cola, G. (European Scientific Information Processing Centre, Ispra, Italy); Stein, A.; Guzzi, G. Newslett. ENEA Comput. Programme Libr.; No. 15, 13-29(Nov 1973).

The computer system and data processing methods for processing gamma spectra from Ge(Li) and NaI(Tl) spectrometers are described. The gamma processing system is being developed for gamma scanning of spent fuel elements, the fission products measured after fuel dissolution, sample activation analysis, and neutron activation analysis. A large system using an IBM 370/165 computer and a small system using a Laben 70 computer are described. (WHK)

5226 TIME-OF-FLIGHT NEUTRON SPECTROMETER USING TRACK-ETCH TECHNIQUES. Ewing, R. I. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 17: 92-93(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5227 SYSTEM FOR THE AUTOMATED ACQUISITION AND REDUCTION OF NEUTRON ACTIVATION ANALYSIS DATA. Friedman, M. H.; Tanner, J. T. (Food and Drug Administration, Washington, DC). Trans. Amer. Nucl. Soc., 17: 126(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5228 WALL EFFECT CALCULATIONS FOR PROTON–RECOIL DETECTORS IN BEAM GEOMETRY. Emmons, L. L.; Carpenter, J. M. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 17: 521(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

High Energy Physics Instrumentation

5229 (FRNC-R-25) MECHANICAL RESONANCE DETECTOR FOR MULTIWIRE PROPORTIONAL CHAMBERS. Chase, R. L. (Ecole Normale Superieure, 91 – Orsay (France). Lab. de l'Accelerateur Lineaire). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The mechanical tension in the anode wires of a multiwire proportional chamber must be sufficient to prevent wire displacement due to electrostatic forces between wires but must not exceed the breaking strength of the wires. A technique is described for inferring the tension by measuring the mechanical resonant frequency of the wires. It employs a servomechanism which uses the small capacitance change of the selected wire to tune a variable frequency oscillator to the mechanical resonance. Since it is not necessary to observe the wires visually, the technique is applicable to closed chambers in inaccessible locations. (FR)

5230 (FRNC-R-28) TESMO 0702: MEMO TEST. Note CAMAC 17-00. Berst, J. D.; Dadoun, M.; Meyer, J. M.; Metzger, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Physique du Noyau et de Physique des Particules). Feb 1973. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The TESMO unit was designed to test the hybrid integrated memory circuits for the touched wires of a multiwire chamber. These memory or "MEMO" circuits are connected together in groups containing 32 elements in the CAMAC unit. These units are interconnected and individually controlled by a C.CTR connected to the SCRO-BRANCH DRIVER which is itself controlled by the SCRO. The unit consists of two 16 bit registers, capable of being filled or modified by a computer. The configuration read by the SCRO is compared with the configuration emitted by TESMO. (FR)

5231 (LA-5396-MS) MULTIWIRE PROPORTIONAL CHAMBER SPECTROMETER FOR NUCLEON–NUCLEON EXPERIMENTS. Werren, D. W.; Brown, D.; Fox, L. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

A flexible low resolution spectrometer is being built for a program of experiments to be done at the LAMPF Nucleon Physics Lab. The bend angle of charged particles through an 18D36 magnet will be determined by multiwire proportional chambers (MWPC) with 2-mm wire spacing. The general design of the chambers and of the associated electronics for readout and encoding are discussed. Some results obtained with a prototype system are given. (auth)

5232 (LNF-73/26) PERFORMANCE OF CYLINDRICAL WIDE GAP SPARK CHAMBERS WITH TRANSPARENT WIRE ELECTRODES. Ash, W. W.; Monacelli, P.; Piccolo, M.; Ronga, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 4 Jun 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

Two large wide-gap spark chambers with transparent wire electrodes will be used for the measurements of the outgoing particle momenta in the magnetic spectrometer experiment (MEA) at Adone. The chambers have four gaps each with cylindrical electrodes and cannot be viewed in the usual way, that is through the plexiglass frames because of the presence of iron in the magnetic flux return. The magnet is a 2-meter long solenoid with a diameter of 2 meters and axis perpendicular to the electron positron beams. The use of wire electrodes instead of the usual aluminium foils, reduces the multiple coulomb scattering and more importantly allows one to view the sparks through the transparent electrodes themselves. In this way the complete special reconstruction is made possible even using only one view. For the construction and the search of good working conditions of these chambers, with about 2 m^3 of sensitive volume, many difficulties due to the great dimensions, to interference problems between the gaps, and to the effects caused by the distortion of the electric field at the edges must be overcome. The solution to these problems obtained at first using some small dimension prototypes and then the final chambers is discussed, and the precision one can achieve in the momentum reconstruction using these chambers is reported. (WHK)

5233 (LUIP-CR-73-6) EXPERIMENTAL STUDY OF THE FORMATION OF TRACKS OF FAST HEAVY IONS IN ILFORD G5 NUCLEAR EMULSIONS. Jensen, M.; Larsson, L.; Mathiesen, O.; Rosander, R. (Lund Univ. (Sweden). Fysiska Institutionen). Jun 1973. 9p. (CONF-730804-3). Dep. NTIS (U. S. Sales Only) $3.00.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

Transverse absorption profiles of tracks of heavy nuclei with charge numbers 14, 16, 20, 24 and 26 were measured in Ilford G5 nuclear emulsions using a nuclear track photometer with a slit whose width reduced to the emulsion plane is 0.3 μm. The measurements covered the velocity interval $0.3 \leq \beta \leq 0.8$. The velocity is obtained from known values of the charge number and the residual range of the particle. The measured track profiles are compared with the track formation model by Katz and coworkers. According to our preliminary results reasonable agreement between experimental and calculated profiles can be obtained if the backscattered light is considered. The work is still in progress. (auth)

5234 (N-73-22210) MULTIWIRE PROPORTIONAL CHAMBER DEVELOPMENT. Final Report, 1 November 1970–31 December 1972. Doolittle, R. F.; Pollvogt, U.; Eskovitz, A. J. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jan 1973. Contract NAS9-11315. 116p. (NASA-CR-128899). NTIS.

The development of large area multiwire proportional chambers, to be used as high resolution spatial detectors in cosmic ray experiments is described. A readout system was developed which uses a directly coupled, lumped element delay-line whose characteristics are independent of the MWPC design. A complete analysis of the delay-line and the readout electronic system shows that a spatial resolution of about 0.1 mm can be reached with the MWPC operating in the strictly proportional region. This was confirmed by measurements with a small MWPC and ^{55}Fe x-rays. A simplified analysis was carried out to estimate the theoretical limit of spatial resolution due to delta-rays, spread of the discharge along the anode wire, and inclined trajectories. To calculate the gas gain of MWPC's of different geometrical configurations a method was developed which is based on the knowledge of the first Townsend coefficient of the chamber gas. (auth)

Radiometric Instruments

5235 STUDIES ON HETEROGENEOUS SYSTEMS WITH THE HELP OF IONIZING RADIATION. Use of Reflected Scattering of B Particles for Evaluation of A System of Solid-gas or Powder. Jombik, J.; Contofalska, M. (Univ., Bratislava). Radiochem. Radioanal. Lett.; 15: No. 3, 147-155(20 Oct 1973). (In German).

Changes in the intensity of backscattered β-radiation depending on the particle size of the solid phase were measured in a solid phase-gas system. The selected samples were pharmaceutical raw materials for the manufacture of dusting powders. Using constant conditions, the method suggested seems to be useful in testing the homogenity of powdered drugs, to choose the suitable diluent in case of powder composites and in testing the fineness of solids in suspensions administered parenterally. (auth)

5236 RADIOISOTOPE METHOD OF VOID FRACTION MEASUREMENT USING TWO PHOTON SOURCES. LeVert, F. E. (Tuskegee Inst., AL). Trans. Amer. Nucl. Soc.; 17: 120(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5237 INTERZONE LAYER CONTROL WITH A GAMMA GAUGE. Elias, E.; Notea, A.; Segal, Y. (Technion–Israel Inst. of Tech., Haifa). Trans. Amer. Nucl. Soc.; 17: 122-123 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 5563.

5238 EFFECTS OF ELECTRON BOMBARDMENT ON THE NOISE IN JUNCTION GATE FIELD-EFFECT TRANSISTORS.

Krishnan, I. N.; Chen, T. M. (Univ. of Florida, Tampa). Solid State Electron.; 16: No. 11, 1233-1240(Nov 1973).

The effects of electron bombardment on the various noise sources in n-type channel and p-type channel junction gate field effect transistors have been investigated in detail. It is shown that generation recombination (g-r) noise is the most sensitive noise source to electron bombardment. The noise frequency spectra obtained after each bombardment level are shown to be characterized by two distinct time constants, one due to traps in the gate channel depletion region and the other due to traps in the channel. (auth)

5239 MEASUREMENT OF LOW TEMPERATURES: TEMPERATURE SCALES AND STANDARD METHODS. Koeppe, W. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 15: No. 8, 345-352(1973). (In German and English).

Temperature scales and standard methods of measuring low temperatures are reviewed. The effect of reactor radiation and of magnetic fields on electrical temperature sensors is also briefly described. (GE)

5240 ENHANCEMENT OF CO_2-LASER OUTPUT BY NUCLEAR RADIATION. Davis, J. D.; Schneider, R. T.; Shipman, G. R. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 17: 4-5(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5241 RADIATION EFFECTS STUDY FOR THE VIKING MARS SOFT LANDER. Diederich, D. P. (Martin-Marietta Aerospace, Denver); Newell, D. M.; Russell, R. A. Trans. Amer. Nucl. Soc.; 17: 10-11(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Miscellaneous Instruments

Refer also to abstracts 4817, 6913, 7267, 7354, and 7409.

5242 (DNPL/NSF/R-5, pp 208-216) ION OPTICS STUDIES FOR THE NSF 20/30 MV VAN de GRAAFF. Joy, T. (Daresbury Nuclear Physics Lab., Eng.); Lisle, J. C.; Phillips, W. R.; Chapman, R. 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

An outline is given of the beam optics calculations that have been carried out for the Daresbury NSF 20/30 MV Van de Graaff accelerator. An interactive computer program originally designed for high energy physics beam design was employed, modified to include all the optical elements required for the NSF machine. Apart from conventional elements these made provision for uniform electric field sections to simulate the action of an accelerator tube, and an algorithm to include the effect of small angle scattering at gas and foil strippers. The program has proved invaluable in enabling investigation of the effects of changes to a system with a large number of interdependent parameters to be made quickly. The interactive technique also makes it possible to examine the effect on trajectories of various abnormal or fault conditions. The effect of small variations in field strengths and voltages can be studied and the required stabilization can be determined. The general optical layout is shown. Matters considered include injection optics, terminal optics, and high energy tube optics. (UK)

5243 (SGAE-2161) CAMAC: PRESET COUNTER CZV-2. Bartel, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Aug 1973. 17p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A CAMAC module, which counts pulses up to 50 MHz into a counting register is described. The content of this register is compared with the content of a register preset via the Dataway. If the contents of the counting register and the preset-register are equal, a LAM signal is generated. (auth)

5244 MEASUREMENT OF HELIUM ISOTOPES IN A MAGNETIC-RESONANCE MASS SPECTROMETER. Mamyrin, B.A.; Shustrov, B.N.; Anufriev, G.S.; Boltenkov, B.S.; Zagulin, V.A.; Kamenskii, I.L.; Tolstikhin, I.N.; Khabarin, L.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 17: No. 12, 2001-2005 (June 1973).

A mass spectrometer is described with a sensitivity of $\approx 10^{-13}$ torr for partial gas pressure in the source and a resolving power of $\approx n \cdot 10^3$ at 10^{-3} of the peak level in resolving doublet lines; the line shape is also good (the tail due to He^+ in the region of the He^3 peak is below 10^{-10}). The limiting sensitivity (at a signal-to-noise ratio of unity) is $5 \cdot 10^3$ atoms in a He^3 sample. For an isotope ratio $He^3/He^4 \approx n \cdot 10^{-8}$ a sample with a helium content of 10^{-5} cm³ at normal pressure is required for a measurement accuracy of $\pm 2\%$. These parameters make it possible to measure isotope ratios down to 10^{-10}. It is possible to measure simultaneously the peaks for both helium isotopes, to program the temperature rise in annealing solid samples with the gas admitted directly to the mass-spectrometer chamber, and to prepare standard samples with isotope ratios that can vary over wide limits. The device has been in operation at the A. F. Ioffe Physicotechnical Institute, Academy of Sciences of USSR, for four years and has been shown to be highly reliable. The device has solved a number of problems in isotope analysis of helium from the earth's interior, the earth's atmosphere, lunar soil, and a number of structural materials. (auth)

5245 DYNAMIC MASS SPECTROMETRY. Volume 3. Price, D. (ed.). Philadelphia; Sadtler Research Laboratories, Inc. (1972). 348p. (CONF-710741-).

Topics include applications of inhomogeneous oscillatory electric fields in ion physics, negative ion studies using a time-of-flight mass spectrometer, the application of dynamic mass spectrometers to problems in gas analysis, flash photolysis in the vacuum ultraviolet, flash photolytic decomposition of nitrosyl chloride studied by time-of-flight mass spectrometry, flow conditions pertinent to flash photolysis performed in the fast reaction chamber of a Bendix time-of-flight mass spectrometer, the kinetics of methyl radical reactions at high temperatures by mass spectrometric sampling behind reflected shock waves, a mass spectrometric study of shock heated carbon dioxide and water, gas evolution from molten glass, time-of-flight mass spectrometry of molecular gas discharges, thermal volatilization analysis by mass spectrometry, study of inelastic ion molecules using a time-of-flight mass spectrometer, a coincidence time-of-flight mass spectrometer, laser volatilization of surface layers, nonlinear behaviour and recovery time from saturation of the electron multiplier, and analysis of steroid hormones by a new direct gas chromatograph/mass spectrometer interface. (WHK)

5246 ROLE OF ENERGY-DISPERSIVE X-RAY SPECTROMETERS IN COMPARISON WITH WAVELENGTH-DISPERSIVE APPARATUSES. . Dietzsch, W. (VEB RFT Messelektronik, Dresden). Isotopenpraxis; 9: No. 4, 117-120(Apr 1973). (In German).

For the determination of elements having atomic numbers below 12, energy dispersive x-ray fluorescence analysis is compared with wavelength dispersive spectrometry. Energy dispersive techniques, using an external alpha source, a semiconductor detector, and single- or multichannel analyzers, are suitable particularly for process control and geological exploration. The various types of available equipment are discussed and the directions for further development are outlined. (HBG)

5247 IMPROVEMENTS IN OR RELATING TO ION SOURCES FOR MASS SPECTROMETERS. Tushingham, R.; Roberts, B. J. (to United Kingdom Atomic Energy Authority). British Patent 1,328,882. 5 Sep 1973. Filed date 6 May 1970. 3p.

Reference is made to ion sources suitable for use with gaseous samples, such as UF_6. Such a gas may attack the electrodes of a mass spectrometer ion source or react with substances adsorbed on the electrode surfaces, and the reaction products may cause change in the source characteristics in a random manner. The useful life of the source between clean-ups is limited by these effects, and varies as its sensitivity. Low sensitivity requires increased sample flow for measurements, with increased build-up of insulating film. It is therefore desirable to use a form of source that does not rely mainly, as hitherto, on the action of a slit in a collimating electrode on a divergent ion beam in order to define the final beam. A large proportion of the initial ions is captured by the collimating electrode in such an arrangement and do not enter the magnetic analyzer. In the form of ion source described an ionizing region is provided within which substantially all ion formation is effected. Spaced therefrom are first and second electrodes, a focussing electrode and a collimating electrode, all with slits for the passage of ions from the ionizing region. The electrodes are dimensioned and spaced in relation to the potentials applied to them, that after a cross-over approximately in the plane of the first electrode an image of the ionizing region is formed on the incident side of the second electrode, and a divergent beam therefrom, leaving the second electrode, is caused by the focussing electrode to provide at the collimating electrode a beam whose width is only slightly greater than the width of the slit therein. The ionizing region may comprise means for forming ions from a gas by bombardment with an electron beam directed transversely to the source axis. The potential applicable to the focussing electrode may be such that the second

electrode acts as a strong convergent lens and the very slightly divergent beam leaving the second electrode is caused by the divergent action of the focussing electrode to direct a slightly divergent beam towards the collimating electrode. (UK)

5248 AUTOMATIC INTRODUCTION OF SAMPLES FOR A SINGLE COLLECTION MASS SPECTROMETER. Satooka, S. (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 49: No. 4, 117-129(Jul 1973). (In Japanese).

An automatic apparatus to be used for sample introduction and measuring operation in a single collection mass spectrometer which is used for the measurement of isotopic ratio was developed. This apparatus manages automatically the setting of 40 argon samples in about 7 h and records the ion peaks for isotopic ratio. The operation is labor-saving and the number of measured samples per day is doubled. This apparatus is composed of a sample introduction system and a controller system. In order to reduce the handling time of samples, the sample introduction system has two reserviors and two evacuation devices. The controller system consists of two sequencers and their accessories which are used for the measuring operation and sample introduction. (auth)

5249 FISSION GAS AND VOID VOLUME MEASURING SYSTEM. Lazarus, M. E. (Los Alamos Scientific Lab, NM). Trans. Amer. Nucl. Soc.; 17: 507-508(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotopic Power Sources

Refer also to abstracts 5001, 5003, and 5437.

5250 (MLM-2076) ENCAPSULATION OF ThO_2 IN MOLYBDENUM LINERS VIA HOT PRESSING. Pardieck, W. D. (Mound Lab., Miamisburg, Ohio (USA)). 11 Oct 1973. Contract AT-33-1-GEN-53. 12p. Dep. NTIS $4.00.

Encapsulation of ThO_2 powder in molybdenum liners using hot pressing techniques was demonstrated. ThO_2 was used as a simulant for $^{239}PuO_2$. Five discs were hot pressed in an effort to establish die design and pressing parameters. Dies were designed to receive cups made of 0.005-in. or 0.031-in. molybdenum. Pressing temperatures of 1850°C and 1450°C were tried. A ThO_2 disc of 88% theoretical density was successfully hot pressed inside a cup fabricated from 0.031-in. molybdenum. The disc was pressed at 1850°C and 3800 psi. (auth)

Radiation Sources

Refer also to abstracts 5170, 5311, 5386, and 6438.

5251 (RISO-M-1651) 10,000 Ci ^{60}Co FACILITY AND THE 3000 Ci ^{60}Co GAMMA CELL. Bjergbakke, E.; Larsen, E. E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The report describes the two gamma irradiators and their calibration. (auth)

5252 INEXPENSIVE POINT SOURCE FOR RAPID TRANSMISSION SCANNING. Berke, R. A. Nuclear Medicine Technical Note, DHEW Publication No. (FDA) 73-8020. Cincinnati; Bureau of Radiological Health (1972). 4p.

In the diagnosis of pericardial effusion, superimposition of a chest roentgenogram and a blood pool scan is the usual method. However, the roentgenogram always has some degree of magnification, and patient positioning usually varies between the roentgenogram and the blood pool scan. These difficulties can be eliminated by substituting a transmission scan for the roentgenogram. Large-volume plate sources have been used for this purpose, but they have several disadvantages. The use of point sources with single- or dual-head rectilinear scanners eliminates these problems and makes the scanner more versatile. A method is described whereby the syringe containing the radiopharmaceutical to be used for the blood pool scan can be utilized as a "point" source simply by placing it in a collimated holder. (WHK)

5253 X-RAY ANALYSIS SYSTEM FOR DETECTION OF CONCEALED EXPLOSIVES AND WEAPONS. Sterk, A. A. (General Electric Co., Philadelphia). Trans. Amer. Nucl. Soc.; 17: 112(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Design and Fabrication

5254 USE OF RF-SPUTTERING TO PREPARE THIN-FILM RADIATION SOURCES. Jarrett, J. H. (Battelle Memorial Inst., Richland, WA); Riemath, W. F.; Culver, G. G. Trans. Amer. Nucl. Soc.; 17: 92(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Industrial Uses

Refer also to abstracts 4918, 5293, and 5304.

5255 (AAEC/TM-625) PRODUCTION AND PROPERTIES OF WOOD-PLASTIC COMPOSITES. Moore, P. W.; Sangster, D. F.; Cirigottis, A. A.; Eric, B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1972. 80p. Dep. NTIS (U. S. Sales Only) $6.00.

Methods for the production of wood–plastic composites (WPC) have been modified, and in most cases simplified to suit Australian conditions. For general applications coachwood and a mixture of styrene, methyl methacrylate and polyester best satisfied the raw material requirements with regard to cost, convenience, availability, and quality of product. The use of solvents and different impregnant formulations often caused minor differences in the product but rarely produced an improvement in properties. There was no evidence that the plastic penetrated the walls of the wood vessels and fibres, and consequently it is believed that grafting is absent in WPC prepared by the usual methods. A number of mechanical properties of WPC were measured, and the results agree broadly with previously published results. Other properties such as the resistance to staining, weathering, and the absorption of water were somewhat disappointing, and were shown to be limited by the nature of WPC itself, that is the fact that unprotected wood in the surface of WPC is open to attack. The most promising applications examined appear to be parquetry flooring, gold club heads, door handles and knobs. A number of test floors were subjected to use under various conditions, and WPC parquetry was found to be superior to conventional parquetry under conditions of heavy wear. (auth)

5256 (AAEC/TM-626) COST ANALYSIS FOR WOOD–PLASTIC COMPOSITE PARQUETRY FLOORING. Moore, P. W.; Cirigottis, A. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1972. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The cost of producing wood plastic composite (WPC) parquetry flooring in Australia by irradiating unseasoned coachwood strips with a polyester based impregnant, was estimated at $3.70 per square yard. Raw materials represent about 47%, processing about 37%, and irradiation about 16% of the total manufacturing costs. When marketing costs, interest, and profit are included the selling price is expected to be about $8.70 per square yard ex factory. This figure is similar to prices quoted or estimated by the three commercial manufacturers of WPC parquetry in the United States. At an estimated $11 to $17 per square yard, laid, the capital cost of WPC parquetry will be higher than competing types of floor covering; however maintenance costs are or will be lower and average life longer. Aesthetic considerations and personal preference may confine the use of WPC to heavy wear areas, and other specialized situations. (auth)

5257 (BFL-3/1973) ELECTRICAL (AC) RESISTANCE OF IRRADIATED FISH: QUALITY CONTROL AND DETECTION OF IRRADIATION TREATMENT. Ehlermann, D. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany). Inst. fuer Strahlentechnologie). Apr 1973. 101p.

Irradiation of fish with doses of 200 krad and higher causes an alteration of the electrical properties of the tissue. The "Q-value" quantity calculated from impedance measurements at higher frequencies (16 and 100 kHz) is not influenced by an irradiation treatment and is a measure of the true storage time of the fish. The Q-values obtained at lower frequencies (1 and 16 kHz) are rather dose sensitive and can be used to identify fish irradiated with doses above 200 krad if the true storage time is known from measurements at the higher frequencies. However, impedance measurements on single fish have little significance. Because of biological variations, the decision of whether or not a particular batch of fish has been irradiated can only be made on the basis of measurements on a sufficiently large number of samples. (GE)

5258 (DP-MS-73-50) CALIFORNIUM-252: NEUTRON SOURCE FOR INDUSTRY AND MEDICINE. Reinig, W. C.; Permar, P. H.; Cornman, W. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 91p. (CONF-731116-1). Dep. NTIS $6.75.

From eleventh conference on radioisotopes; Tokyo, Japan (13 Nov 1973).

The history, production, and availability of ^{252}Cf and its many potential uses are discussed. Applications in life sciences, education, chemical analysis, exploration for natural resources, industrial process control, neutron radiography, nondestructive inspection, and neutron flux enhancement are described. (TFD)

5259 (IRE-1-A-1973) SHORT NOTE ON A LIGHTNING ROD USING KRYPTON-85. Depoitier, J.; Constant, R. (Institut National des Radioelements, Brussels (Belgium)). Jan 1973. 4p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Lightning conductors using radioactive sources have been known for a long time. These radioactive sources, which due to their ionic performance must increase the protected surface, are usually of α sources. In this report a ^{85}Kr β source is described. Considered as a rare gas, ^{81}Kr is non-contaminating, moreover

it occupies the least high class on the scale of radiotoxicity, the opposite of α transmitters which belong to the highest class on the scale. The activity of the ^{85}Kr source has been fixed at an adequate value and the ionic density created by this source is the same as that presented by the more powerful α lightning conductors. Finally, contrary to the α transmitters which present a high risk of contamination, the ^{85}Kr source has been connected to earth. (auth)

5260 (ORO-4156-2) EVALUATION OF TREATMENT PLANTS BY TRACER METHODS. Final Report, January 15, 1971–March 15, 1973. Craft, T. F.; Eichholz, G. G.; Millspaugh, S. N. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). Apr 1973. Contract AT(40-1)-4156. 97p. Dep. NTIS $7.60.

To overcome the practical difficulties associated with the use of radiotracers or dye markers in evaluating the performance of sewage treatment plants, the use of stable elemental tracers followed by post-sampling neutron activation analysis was investigated. Of the various possible tracer elements, indium offers the greatest attraction on account of its high neutron capture cross section, its absence from most natural waters, and its low toxicity. Tests have been performed to establish the most convenient procedure for using tracers in soluble form or adsorbed on various particulates in investigations of treatment plant performance. Field tests have been conducted at several treatment plants in the Atlanta, Georgia region. The performance of sedimentation basins, trickling filters, and activated sludge tanks has been studied and abnormal operating conditions have been demonstrated in some cases. It was shown that the inert tracer method, coupled with subsequent activation analysis, provides a powerful and convenient method of testing the performance of treatment plant characteristics. Inert tracers are easier to introduce into the normal plant routine than radioactive tracers would be and results can be made quantitative with greater assurance than any dye tracer. (auth)

5261 RADIOTRACER INVESTIGATION OF THE ADSORPTION OF n-OCTANOIC ACID ON MILD STEEL. Marshall, R. A. G.; Rogers, T. J. (Thomas Polytechnic, London). J. Inst. Nucl. Eng.; 14: No. 4, 99-102(Jul 1973).

The adsorption of n-octanoic acid on mild steel was studied as part of studies on corrosion inhibition by fatty acids. Labelling with ^{14}C was employed so that surface concentrations down to 10^{-13} mole/cm^2 could be detected. It was found that adsorption was rapid and reached a constant value within about 30 min. The adsorption obeyed the Freundlich isotherm in the concentration range 10^{-6} to 10^{-5} molar and showed very little variation with temperature. About 80% of the adsorbed acid could be removed by washing or exchange. It was concluded that the principal forces involved in the process are van der Waals forces. Autoradiographic examination showed some concentration at surface flows and emphasized the importance of good surface preparation. (UK)

5262 INVESTIGATION OF THE CLEANING OF COARSE TEXTILE FIBERS WITH THE HELP OF TRACER TECHNIQUES. Hecht, P.; Langrock, E. J. (Zentralinstitut fuer Isotopen und Strahlenporschung, Leipzig). Isotopenpraxis; 9: No. 5, 188-189 (May 1973). (In German).

Coarse textile fibers were dirtied with a test material containing clay with or without the additional powdered thorium oxide. In the first case, the ^{24}Na was measured after neutron activation. In the second case, the thorium was directly determined by halogen counters. The dirty samples were cleaned with either a moist or a dry procedure. For moist cleaning, both neutron activation and thorium addition yielded the same results. For dry cleaning, however, thorium indicated a much lower cleaning efficiency. The findings demonstrated that the naturally radioactive elements could be used within limits as useful, harmless, and inexpensive tools. (HBG)

5263 ISOTOPE AND RADIATION TECHNIQUES IN HUNGARY. Foeldiak, G. (Institut fuer Isotope, Budapest). Isotopenpraxis; 9: No. 2, 41-47(Feb 1973). (In German).

Use of radioactive isotopes and other radiation sources is presented for Hungary. The organization of the radiation field within the country, the annual use of isotopes as well as the application in research, industry, medicine, and agriculture are discussed. The supply by internal production and by import is analyzed for radionuclides and measuring devices. Educational programs as well as dissemination of pertinent information within Hungary are outlined. (HBG)

5264 COMPOSITION FOR GRAVURE PRINTING PLATES. Beacham, J. F. (to B.K.T. Desplays Ltd.). British Patent 1,325,875. 8 Aug 1973. Filed date 13 Aug 1969. 4p.

Reference is made to photogravure plates of the kind described in BP 1,325,874. Compositions for use in the method of that specification are described. These comprise (1) a resinous material, hardenable by irradiation, and (2) a photographic material, in which irradiation produces inappreciable hardening, for production of an image. The hardenable material may comprise a linear polyamide such as polyurethane, and may contain a cross-linking agent; it may also contain a pigment. The photographic material may be a silver halide. (UK)

5265 METHOD OF MAKING GRAVURE PRINTING PLATES. Beacham, J. F. (to B.K.T. Desplays Ltd.). British Patent 1,325,874. 8 Aug 1973. Filed date 13 Aug 1969. 10p.

Reference is made to photogravure plates of the kind in which the image to be printed is represented by an intaglio cell pattern on the surface of the printing plate, the cells being regularly distributed and of uniform size in plan but of varying depth according to the required density of the print at any given point–the deeper the cell the more ink it will contain and therefore the more dense the print image will be at that point. The method described for making a gravure printing plate comprises the steps of producing in one surface of a layer of resinous material that is hardenable by irradiation a pattern of hardened cell walls, and an image in irradiation resistant material, and then irradiating the material, followed by removal of the unhardened material from within the cells. The irradiation resistant material may contain a silver halide, producing a silver image on development. Suitable resinous materials are indicated. The cell pattern may be produced by exposing the surface to hardening radiation through a negative screen bearing a pattern of discrete opaque areas representing the cells, separated by transparent regions representing the cell walls. The surface layer may be applied by roller and the irradiation conducted during rotation of the roller from a source located within the interior of the roller. Various alternative methods of application of the process are described. (UK)

5266 INDUSTRIAL STERILIZATION. Proceedings of An International Symposium Held in Amsterdam, 1972. Phillips, G. B.; Miller, W. S. (eds.). Durham, NC; Duke University Press (1973). 436p. (CONF-7209100-). $12.50.

Separate abstracts were prepared for ten of the papers presented at the Conference. The remaining twelve papers were not within the scope of NSA. (TFD)

For abstracts of individual papers see: 5267–5271, 5303–5306, and 5585.

5267 FACTORS DETERMINING CHOICE OF STERILIZING PROCEDURE. Bruch, C. W. (Food and Drug Administration, Washington, DC). pp 119-123 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

The safety and efficacy of a medical item are affected by the choice of sterilizing agent. The basic issue with efficacy is that the product meet certain performance standards (potency and stability with pharmaceuticals) following sterilization. Drugs which require a NDA before marketing are reviewed for the possibility of an effect of the sterilizing process on drug potency and quality. With medical devices the burden of proof for efficacy before marketing rests with the manufacturer since preclearance is not required. The basic safety issue is that the product be sterile and nontoxic following sterilization. The sterility tests described in the drug compendia (USP and National Formulary) are considered to be minimal requirements to be met before an item is marketed. The only sterilant for which a legal mandate exists to prove nontoxicity is ionizing radiation applied to drugs. No governmental standards exists for the presence of ETO residues in medical products, but the Z-79 Subcommittee of ANSI is in the process of publishing interim guidelines for such residues in plastic materials and devices. (auth)

5268 CONTROL OF THE MANUFACTURE AND SALE OF DISPOSABLE PLASTICS IN THE UNITED KINGDOM. Bishop, A. (Ministry of Health and Social Security, London). pp 125-130 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

The following topics are discussed: legal aspects of the control of medicinal products and medical supplies; assessment of sterility of plastic products by exposure to ethylene oxide or irradiation; lists of approved manufacturers; control requirements for radiation sterilization with emphasis on dosimetry; control requirements for ethylene oxide sterilization; and toxicity control. (HLW)

5269 TEN YEARS OF STERILE PRODUCTS CONTROL IN BELGIUM. Huyghe, B. J. A. (Ministry of Health, Brussels). pp 131-137 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

Legal aspects of the manufacture, preparation, and wholesale distribution of drugs and medical supplies in Belgium are discussed. Requirements for holders of an authorization for manufacture, preparation, or import of regulated material are listed. Methods of sterilization recognized by the Belgian Pharmacopoeia include exposure to x rays, gamma rays, or cathode rays, exposure to dry heat, and others. Criteria for packages and materials are listed for manufacturers of disposable sterile products. (HLW)

5270 DESIGN OF RADIATION STERILIZATION FACILITIES. Eymery, R. (CEA, Paris). pp 153-179 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

To set up an irradiation installation which functions in good technical and economical condition, a careful examination of numerous factors is necessary. The determination of the minimal dose for sterilization of medical items involves a good knowledge of the bacterial contamination before treatment. The choice of the maximal dose should be made in relation to the function of the resistance to the radiation of the substance to be treated. The arrangement of irradiation depends strictly on the packaging of the products and in particular their apparent density. After a brief review of the general characteristics of radiation, the installations and its method of working are described. The gamma irradiation installation includes a certain number of lines on both sides of a flat source. Various solutions are usually possible; the choice depends on technical and economical factors. Different types of conveyors as well as methods for the protection of personnel are described. The electron accelerators present special problems. Here some elements are given for the comparison of the two types of sources. Finally, it is emphasized that the acceptance of radiosterilization involves modifications of the other stages of production. (auth)

5271 STERILIZATION TECHNOLOGY IN THE UNITED STATES SPACE PROGRAM. Hall, L. B. (National Aeronautics and Space Administration, Washington, DC). pp 337-342 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

A general discussion of the NASA spacecraft sterilization program is presented. The sterilization methods include chemical, heat, radiation, and heat and radiation combined. (TFD)

5272 FORENSIC ACTIVATION ANALYSIS: FACT OR FANCY. LaFleur, P. D. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 110(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5273 DETECTION OF LAND MINES BY NUCLEAR TECHNIQUES. Johnson, C. N. Jr.; Small, T. M. (USA Mobility Equipment R and D Center, Fort Belvoir, VA). Trans. Amer. Nucl. Soc.; 17: 110-111(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5274 NUCLEAR TECHNIQUES FOR EXPLOSIVES AND WEAPONS DETECTION. Jones, P. F.; Kennel, R. P.; Stupian, G. W. (Aerospace Corp., El Segundo, CA). Trans. Amer. Nucl. Soc.; 17: 111-112(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5275 SCANNING X-RAY SYSTEMS FOR SECURITY APPLICATIONS. Stein, J. A. (American Science and Engineering, Inc., Cambridge, MA). Trans. Amer. Nucl. Soc.; 17: 112-113(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5276 DETECTION OF BURIED OBJECTS BY IMAGING BACKSCATTERED RADIATION. Coleman, W. A.; Huffman, D. L. (Science Applications, Inc., La Jolla, CA). Trans. Amer. Nucl. Soc.; 17: 113-114(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 4889 and 6750.

5277 STABILITY OF ABSORBED ENZYMES IN WATER-DEFICIENT SYSTEMS. III. Effect of Electron Irradiation on the Stability of Peroxidase. Roozen, J. P.; Pilnik, W. (State Agricultural Univ., Wageningen, Netherlands). Lebensm.-Wiss. Technol.; 4: No. 3, 93-96(1971). (In German).

Carboxymethylcellulose (CMC) peroxidase, starch peroxidase, and poly(vinylpyrolidinone) (PVP) peroxidase models with different pH values and water contents were irradiated. The radiosensitivity of the enzyme depended on the polymer used as substrate in the model, the pH value, and the water content. Starch and CMC showed an after-effect that minimized the original differences in sensitivity. No after-effect was noticed with PVP peroxidase. (ERB)

5278 STUDIES ON THE SH–SS EQUILIBRIUM IN BIOLOGICAL MEDIA. The Effect of Temperature on the Irradiation of Some SH Proteins. Olinescu, R. (Clinical Hospital Fundeni, Bucharest); Visinescu, A. Rev. Roum. Biochim.; 9: No. 3, 243-250(1972).

The reaction between DTNB, a specific reagent for the SH groups, and some irradiated and nonirradiated proteins was studied. After irradiation, as the catalytic activity of some enzymes such as hexokinase and phosphoglucomutase decreased by 40%, the SH groups were almost completely oxidized. The influence of temperature on the reaction, significant for nonirradiated proteins, becomes insignificant after irradiation. The thermodynamic study of the first period of the reaction, the fast one and of the first order, shows that after irradiation the thermodynamic constants decreased and the protein molecules become more rigid. The consequences of this rigidity on the protein molecules are discussed. (auth)

5279 POSTREPLICATION REPAIR IN AN EXCISION-DEFECTIVE MUTANT OF ESCHERICHIA COLI. Ultraviolet Light Induced Incorporation of Bromodeoxyuridine into Parental DNA. Ley, R. D. (Argonne National Lab., IL). Photochem. Photobiol.; 18: No. 2, 87-95(Aug 1973).

Ultraviolet light-induced incorporation of bromodeoxyuridine (BrdUrd) into parental DNA of an excision-defective mutant of Escherichia coli was observed by selective photolysis of bromouracil (BrUra)-containing regions in the parental DNA. It appears that the BrUra-containing regions occur only in that DNA which has served as a template for normal semiconservative replication. After an exposure at 254 nm which results in one pyrimidine dimer per 45×10^6 daltons, incubation in BrdUrd resulted in BrUra-containing regions $\sim 1.5 \times 10^4$ nucleotides in length at intervals of $\sim 55 \times 10^6$ daltons in the parental DNA. Thus approximately one BrUra-containing region has occurred for every 1.2 pyrimidine dimers in the parental DNA. The observed incorporation of BrdUrd is interpreted in terms of a proposed model for postreplication repair in which genetic exchanges produce single-strand gaps in the parental DNA. (auth)

5280 RADIOPROTECTION (UV AND GAMMA RAYS) OF DNA MOLECULE BY INDOLE AND INDOLE-DERIVATIVES. Tomicic, I.; Pieber, M.; Romero, C.; Soto, A.; Toha, J. C. (Chile Univ., Santiago). Z. Naturforsch.; 28c: No. 7/8, 379-385(1973).

The radioprotective ability of L-tryptophan, tryptamine, 3-indoleacetic acid, and indole (10^{-4} M), on uv- and gamma-irradiated DNA (10^{-4} M) is studied. UV radioprotection is accomplished in the following order of efficiency: L-tryptophan and 3-indoleacetic acid > indole and tryptamine. The corresponding DRF (dose reduction factor) measured as absorbancy loss at 260 nm, were: L-tryptophan and 3-indoleacetic acid around 3 and tryptamine and indole around 1. When absorbancy loss plus changes in the patterns of the absorbancy curve were considered the DRF was: L-tryptophan 2.53, 3-indoleacetic acid 1.54, indole 1.22, and tryptamine 0.75, respectively. For gamma radiation damage the order of radioprotection found was: indole, L-tryptophan and tryptamine > 3-indoleacetic acid. The DRF when comparing the absorbancy loss at 260 nm was: L-tryptophan, indole, and tryptamine around 11 and 3-indoleacetic acid around 4. When evaluating total changes in absorbancy the DRF were: indole and L-tryptophan around 6.5, tryptamine 3.7, and 3-indoleacetic 2.1. These data were correlated with measurements of the degree of molecular interactions of DNA and protectors, studied by: Spectrophotometry, m.p. determinations, circular dichroism and oriented circular dichroism, viscosity, and rate of dialysis. Also data of fluorescence and phosphorescence were considered. For gamma radioprotection a mechanism based in radical trapping, local radical trapping, and partial recovery of radioprotectors is proposed. UV radioprotection is discussed considering: The close interaction of L-tryptophan with DNA which might impede dimer formation, its proton and electron donor ability. A possible (triplet-triplet) energy transfer from excited DNA to indole derivative is discussed on the basis of acetone competition and a dimer excision process considered. (auth)

5281 DEPRESSION OF SUBSTRATE INHIBITION IN GAMMA-IRRADIATED LACTIC DEHYDROGENASE. Saito, M. (Kyoto Univ.). Radiat. Res.; 56: No. 2, 334-344(Nov 1973).

Dilute solutions of chicken heart lactic dehydrogenase were exposed to ^{60}Co gamma irradiation. The dose effect curve varied in shape depending on the pyruvate concentration used in the assay of LDH activity. At a lower concentration of pyruvate, the LDH activity decreased exponentially with the dose. However, at an excess concentration of pyruvate, the residual LDH activity initially increased with increasing dose before a loss in activity was observed. The S–V plot of irradiated LDH showed that the substrate inhibition of chicken heart LDH at excess pyruvate concentration was considerably depressed by gamma irradiation. The mechanism of the decreased substrate inhibition was studied by examining the formation of an abortive ternary complex of the type pyruvate–NAD–LDH upon incubation of LDH with pyruvate and NAD. The result shows that irradiation decreases the formation of the abortive ternary complex, resulting in the release from substrate inhibition. (auth)

Radiation Effects on Cells

5282 STUDIES ON THE DIVISION CYCLE OF MAMMALIAN CELLS. VII. X-Ray Sensitivity and Repair Capacity of Synchronously Dividing Murine Mastocytoma Cells. Schaer, J. C.; Ramseier, L. (Allegheny General Hospital, Pittsburgh). Radiat. Res.; 56: No. 2, 258-270(Nov 1973).

Partially synchronous cell populations of a transplantable murine mastocytoma exhibiting a cell cycle time of 8 to 8.5 h were prepared by density gradient centrifugation and reincubation of slowly sedimenting early interphase cells. The single-dose survival curve of such cultures indicated that x-ray sensitivity was high in early S and in G_2 + M, and low in late S and G_1 although these cells have a short G_1 period. Survival curves of cells irradiated at different stages showed pronounced changes in extrapolation number n, whereas the slope D_0 did not vary markedly. In order to assess the cellular ability to repair sublethal damage, the survival ratio was measured at various times after incubation of early interphase cells by the split-dose technique with a 1-h interval. Marked cyclic changes were observed, indicating that mastocytoma cells repair radiation damage most effectively in the middle and second part of S, and to a lesser extent in G_1. These fluctuations in survival ratio were in good correlation with the variations in n. These findings support the view that relative increase in survival after split doses and extrapolation number both are the expression of one single type of cellular repair activity. This is in agreement with the concept originally proposed by Elkind and Sutton that the extrapolation number reflects the extent of cellular recovery from sublethal injury. (auth)

5283 FACTORS INFLUENCING THE REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE IN GROWTH-INHIBITED HUMAN CELLS. Little, J. B. (Harvard Univ., Boston). Radiat. Res.; 56: No. 2, 320-333(Nov 1973).

The cells in growth-inhibited (stationary phase) cultures of Chang human liver cells (LICH) will repair potentially lethal radiation damage (PLD repair) if allowed to remain in the stationary phase of growth for several hours after irradiation. The half-time for PLD repair was 1 to 2 hr, and it was associated with a change in the slope of the survival curve. Repair was independent of whether the cells reached stationary growth by density-inhibition or medium exhaustion. It depended on both cell to cell contact and some factor that developed in the medium of stationary phase cultures. PLD repair was greatly reduced by incubating stationary cultures in fresh medium during the repair interval, whereas a small amount of repair with similar kinetics could be induced in exponentially growing cells by post-irradiation incubation with conditioned medium from density-inhibited cultures. Incubation of stationary or exponentially

growing cells with conditioned medium impeded the progression of G_1 cells into S. The repair process occurs primarily in cells in the G_1 phase of the life cycle. On the basis of these results, it is hypothesized that cells in stationary phase cultures are held up in a particular metabolic state in G_1, which favors the efficient repair of potentially lethal lesions. Conditions that allow the cells to leave this state and progress into S favor fixation of damage and reduced survival. (auth)

5284 CHEMICAL RADIOPROTECTION AND RADIOSENSITIZATION OF MAMMALIAN CELLS GROWING IN VITRO. Chapman, J. D.; Reuvers, A. P.; Borsa, J. Greenstock, C. L. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Radiat. Res.; 56: No. 2, 291-306(Nov 1973).

The radiosensitizing and radioprotective effects of various compounds were characterized in Chinese hamster fibroblasts growing in vitro and in a model chemical system utilizing DNA as target. The contribution to the lethal action of ionizing radiation in mammalian cells from the indirect effect of OH was measured. The data are consistent with the oxygen fixation hypothesis, whereby target free radicals react either with radical-reducing species, resulting in chemical repair, or with radical-oxidizing species, resulting in fixation of radical damage to a potentially lethal form. Radical repair-fixation competition was demonstrated in the in vitro chemical system with a sensitizer other than O_2. Dimethyl sulfoxide is shown to radioprotect in both the cellular and chemical systems by scavenging OH. Cysteamine, on the other hand, is shown to protect primarily by adding to the pool of radical-reducing species, resulting in enhanced repair of free-radical damage in the targets. Electron-affinic compounds are shown to radiosensitize, predominantly, by adding to the pool of radical-oxidizing species, resulting in enhanced fixation of free radical damage in the targets. Diamide is shown to radiosensitize mammalian cells by a mechanism that is additive to that of the electron-affinic compounds. N-Ethylmaleimide shows radiosensitizing characteristics, in mammalian cells, which, in some respects, are qualitatively similar to those of Diamide. These compounds may radiosensitize cells by chemically and/or biochemically altering the pool of radical-reducing species in the vicinity of the cellular targets, resulting in enhanced fixation of radical damage in the targets by endogenous radical-oxidizing species. The oxygen enhancement ratio for hamster cells is shown to depend upon the intracellular target environment, and can be made to vary between near 1 and 3.3. (auth)

5285 SULFHYDRYL CONTENTS OF THE RADIORESISTANT HeLa CELLS AND THEIR CROSS RESISTANCE TO NITROGEN MUSTARD. Morita, K. (Sapporo Medical Coll.). Radiat. Res.; 56: No. 2, 405-410(Nov 1973).

The mechanisms of acquired radioresistance were investigated in the previously established radioresistant HeLa strains by successive treatments with x-irradiation. The amount of nonprotein SH, protein SH, and total SH in the radioresistant strains were found to be higher than in the original strain. Radioresistance of these strains did not correlate with their nonprotein SH, but did correlate well with total SH content. The radioresistant HeLa cells were also found to be cross-resistant to nitrogen mustard. However, no strict parallelism in the degree of resistance between x-ray and nitrogen mustard was found. (auth)

5286 RESTORATION OF DNA SYNTHESIS AFTER ULTRAVIOLET IRRADIATION OF MAMMALIAN CELLS. Buhl, S. N. Knoxville, TN; Univ. of Tennessee (1973). 37p. University Microfilms Order No. 73-27,717.

Thesis (Ph. D.).

DNA synthesized in human cells within the first hour after ultraviolet irradiation is made in segments of lower molecular weight than that in nonirradiated cells. The sizes of the segments in irradiated cells approximate the average distance between pyrimidine dimers in the parental DNA. This finding suggests that the dimers interrupt normal DNA synthesis and results in gaps in the newly replicated DNA. These gaps are left presumably opposite the pyrimidine dimers. Within several hours after irradiation, the smaller units are elongated and joined to form high molecular weight DNA as is observed in nonirradiated cells. The mechanism of elongation and joining involves the insertion of ~10^3 nucleotides-per-gap. This repair system (post-replication repair) has been observed in normal human cells in which the dimers are excised and in the human mutant xeroderma pigmentosum cells in which the dimers are not excised. DNA synthesized in human cells at long times after ultraviolet irradiation is made in segments equal to or nearly equal to those synthesized by nonirradiated cells. The recovery of the ability to synthesize DNA in segments of normal size occurs in normal human cells in which the dimers are excised as well as in xeroderma pigmentosum cells in which the dimers still remain in the DNA. This observation implies that the pyrimidine dimer may not be the lesion responsible for causing DNA to be synthesized in smaller than normal segments. (Diss. Abstr. Int., B)

5287 SOME RADIOBIOLOGIC CHARACTERISTICS OF AN IN VITRO CULTURED RAT SARCOMA CELL LINE. Nash, J. C. Fayetteville, AR; Univ. of Arkansas (1973). 151p. University Microfilms Order No. 73-27,440.

Thesis (Ph. D.).

Because of the great use of radioactive materials and x rays, the study of the radiation response of mammalian tissue is of great importance. It is important that we know as much as possible about the radiation response of not only normal tissue, but also neoplastic tissue. To study the response of neoplastic tissue, the ideal choice would be a cell line of neoplastic origin that retains to some degree, preferably high, the tumorigenic qualities. It should also be relatively easy to maintain in culture. The cell line presented in this study, designated RT-2 was derived by Falk, from a primary fibrosarcoma in a Fischer rat. It is readily adaptable to tissue culture, is highly radioresistant, and retains to a high degree its malignant potential. The purpose of this investigation was to characterize, biologically and radiobiologically the RT-2 cell line, and possibly, to determine the cause of the cell line's high radioresistance. The generation cycle analysis was accomplished using the methods of Kollmorgen, Quastler and Sherman, and Stanners and Till. Qualitatively, the RT-2 cell line responds to x irradiation, after a variety of treatments, like many other common cultured mammalian cell lines. Treatments used in this study include: double thymidine synchronization, sensitization with 5-bromodeoxyuridine, energy deprivation with 2,4-dinitrophenol, and hypoxia. The radiation response of stationary phase cells indicate a reduced capacity to repair sublethal radiation injury. The radiation response as a function of cell age is much like that of other cultured mammalian cell lines with a long G_1 period. Under conditions of energy deprivation, survival is greatly increased, while after sensitization with 5-bromodeoxyuridine, it is greatly reduced. Hypoxic RT-2 cells have a greatly increased radioresistance along with a reduced capacity to repair sublethal injury. RT-2 cells are sensitive to ultraviolet irradiation and demonstrate very little ability to repair sublethal injury from this radiation. Estimates of the DNA molecular weight of RT-2 cells, as determined by alkaline sucrose sedimentation, indicate a value lower than that reported for other cultured mammalian cells. Considerations from target theory concerning target size suggest the low DNA molecular weight (small target) might account for the high radioresistance of the cell line (D_0 of 230 Rads; extrapolation number, N, of 2.6). (Diss. Abstr. Int., B)

5288 STUDIES OF INDUCED ABERRATIONS IN DIPLOCHROMOSOMES OF CHINESE HAMSTER CELLS. Gatti, M.; Rizzoni, M.; Palitti, F.; Olivieri, G. (Inst. of Genetics, Rome). Mutat. Res.; 20: No. 1, 87-99(Oct 1973).

The commoner aberrations that can be scored in a diplochromosome were classified. This chromosome configuration can be useful for a study of the mechanisms that underlie chromosome aberrations. Three experiments were done in which endoreduplicated Chinese hamster cells (strain CHEF-125) were irradiated at various stages in their cell cycle. The results showed good consistency in the three experiments and confirmed that the spatial arrangement of the chromosomes influences both the type and the frequency of the aberrations produced. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 5266, 5267, 5689, and 7432.

5289 (NP-19852, pp 114-118) LET EFFECTS ON BACTERIAL CELLS. Matsuyama, A.; Takahashi, T.; Karasawa, T.; Igarashi, K.; Yatagai, F.; Kitajima, Y. Dec 1972.

5290 EFFECT OF SOME NUCLEIC ACID-BINDING METABOLIC INHIBITORS ON SPLIT-DOSE SPARING IN UV⁻ AND ELECTRON IRRADIATED DIPLOID YEAST. Kiefer, J. (Univ., Giessen, Ger.). Int. J. Radiat. Biol.; 24: No. 1, 93-97(Jul 1973).

The following compounds (known to bind to DNA) were tested for their effect on split-dose sparing in yeast cells: acriflavine (10^{-4} m), hydroxylamine (10^{-2} m), caffeine (0.5%), formaldehyde (10^{-3} m), and actinomycin D (5 g/ml). Stationary diploid yeast cells were exposed to ultraviolet (254 nm) or 12-MeV electrons, using doses to result in a colony-forming ability of about 50% after one fraction (2×50 krad or 2×1180 erg mm^{-2}, respectively). The sparing effect of dose fractionation was inhibited with all

compounds, except for acriflavine (ineffective with uv irradiation) and formaldehyde which prevented sparing only under hypoxic conditions. (UK)

5291 DISINFECTION OF BACTERIA AND SPORES BY GAMMA RAYS. Polyakov, A. A. (All-Union Academy of Agricultural Sciences, Moscow); Kulikovskii, A. V.; Andryunin, Yu. I. Veterinariya; No. 4, 26-31(1973). (In Russian).

The ultrastructure of Staphylococci, Listeria, and anthrax spores was studied with an electron microscope following their exposure to different doses of gamma rays from a ^{60}Co source. For electron microscopy, the cells and spores were fixed with osmic acid, defatted with ethanol, and embedded in methacrylate for sectioning. Exposure of the bacteria to different doses of radiation, including bactericidal doses (0.3 Mrad for Listeria and 0.5 Mrad for Staphylococcus), elicited only minimal changes consisting of localized dissolution of plasma membrane, a less dense cytoplasm, vacuolization of the nuclear region, and aggregation of the nuclear strands. Exposure of the anthrax spores to 0.5 and 1 Mrad of irradiation caused the sporoplasm volume to increase, the outlines of the different coats to be less well differentiated, and germinating spores to be noted. A 2 Mrad dose was sporocidal; spore outline became diffuse, and coat layers became indistinct. The internal structure was poorly differentiated and contained many dense bodies in the sporoplasm. The results showed that gamma rays exert their disinfectant action without exerting pronounced structural changes in bacterial vegetative cells and spores, and death occurs instantaneously after exposure. Sublethal doses induce germination in spores. (JPRS)

5292 STUDIES ON PRODUCTION OF NUCLEIC ACID DERIVATIVES BY MICROORGANISMS. II. Accumulation of 5'-Inosinic Acid by Adenineless Mutant of Brevibacterium Ammoniagenes. Bae, M.; Lee, K. J. Korean J. Microbiol.; 10: No. 3, 109-116(1972).

Three strains among 120 adenineless mutants of Brevibacterium ammoniagenes were screened out to accumulate uv-absorbing substances in the culture broth, analyzed to be 5'-inosinic acid and hypoxanthine by means of two-dimensional paper chromatography, uv absorption spectra, and periodate oxidation. 5'-IMP was isolated from the culture broth of the mutant No. 203 with anion-exchange resin amberite IRA-400 and recrystallized from ethanol. It was proved identical to authentic sample by infrared absorption spectrum. The growth responses of the mutant No. 203 were demonstrated to require adenine, but not with adenosine and 5'-AMP. (Korean Sci. Abstr.)

5293 USE OF IONISING RADIATION FOR FOOD PRESERVATION. Basson, J. K. (Atomic Energy Board, Pelindaba, S. Afr.). Food Ind. S. Afr.; 23: No. 6, 49-53(Oct 1970). (In Afrikaans).

The physical principles of the use of ionizing radiation for the preservation of food are described, taking into consideration the widely available radioactive sources as well as the necessary control measures for ensuring wholesomeness. Complete sterilization is limited by the resulting off-flavors and odors, but pasteurization as well as deinfestation of insects appear as useful additions to existing food preservation methods. The present international situation is summarized, from which it appears that four countries have already given clearance for unlimited consumption of certain irradiated foods. It will be necessary for more countries to give such clearance before there can be a substantial international trade in such products, the most likely of which are believed to be potatoes, onions, grain and flour, fresh fish, chicken, canned hams, and sterilized meat products. Although food preservation by ionizing radiation has not reached an economically competitive stage, South Africa satisfies some of the prerequisites for the useful application of radiation in food processing: first, a mature industrial economy and highly organized food distribution system and second, a large export trade in perishable commodities. In South Africa the only work of consequence has been carried out at the Research Institute for Fruit and Food Technology, Stellenbosch, where a 500-Ci ^{60}Co facility has been in operation since 1961 (this will be increased to 5,000 Ci in the near future). These investigations have concentrated on the irradiation of fresh fruit and vegetables. However, at the National Nuclear Research Centre, Pelindaba, the Atomic Energy Board now has adequate facilities for irradiation studies, including an 18,000-Ci ^{60}Co facility (since June 1968) as well as the dry gamma facility at its SAFARI-1 research reactor, which makes use of spent fuel elements for irradiation purposes. (INIS)

5294 ISOLATION OF RADIORESISTANT VEGETATIVE BACTERIA FROM THE HIGH-BACKGROUND RADIOACTIVITY AREA. Matsuyama, A. (Inst. of Physical and Chemical Research, Wako, Japan); Okazawa, Y.; Arai, H.; Mifune, M. Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 1, 35-40(Mar 1973).

The microflora in the high-background radioactivity areas in Japan was surveyed in order to obtain radioresistant vegetative bacteria. Several strains isolated exhibited appreciable resistance to gamma rays. The induction dose and D_{10} value of the most radiation resistant strain B 12 were 640 and 370 krad with respect to log-phase cells, and 1300 and 353 krad with respect to stationary-phase ones, respectively. By a taxonomic study, strain B 12 was tentatively classified as Micrococcus sp. The results of sedimentation analysis of DNA suggest that remarkable radiation resistance of this strain can be explained in terms of the efficient capacity of DNA repair, as previously indicated with M. radiodurans. (auth)

5295 RADIOSENSITIVITY OF SPORES OF DNA POLYMERASE-DEFICIENT MUTANTS OF BACILLUS SUBTILIS. Terano, H.; Kadota, H. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 59-64(Jan 1973).

The radiosensitivity to γ rays of the spores and the vegetative cells of Bacillus subtilis mutants with the reduced DNA polymerase activity was compared with that of their parent strains. Both the spores and the vegetative cells of the mutants were approximately 2 times as sensitive to γ rays as those of the parent strains. It is suggested that the differences in radiosensitivity between the mutant spores and the parent spores are at least partly attributable to the genetic differences between the strains in themselves. The spores of the mutants employed were biologically normal in many respects with the exception of the sensitivity to chloramphenicol and the cell size. (auth)

5296 X-RAY-INDUCED ALTERATIONS IN MARKER REPLICATION PATTERN IN BACILLUS SUBTILIS W23. Billen, D.; Cain, J. (Univ. of Florida, Gainesville). Radiat. Res.; 56: No. 2, 271-281(Nov 1973).

The effects of x rays on the programming of sequential replication of genetic markers have been studied in Bacillus subtilis. Density transfer and transformation techniques were employed to study the replication sequence of eight genetic markers distributed along the chromosome. It was observed that x-rays caused premature gene replication independent of marker position in both stationary and growing cells. The metA region was observed to be particularly sensitive to premature induction of replication. The loss of control of chromosome cycling is best explained by the induction of new starts scattered through the chromosome. These new initiation sites allow limited semi-conservative replication and could be the result of x-ray-induced primer sites specific for polymerase(s). (auth)

5297 TRANSFORMATION OF HAMSTER EMBRYO FIBROBLASTS BY HERPES SIMPLEX VIRUSES TYPE 1 AND TYPE 2. Rapp, F.; Duff, Ro. (Pennsylvania State Univ., Hershey). Cancer Res.; 33: 1527-1534(Jun 1973).

Hamster embryo fibroblast cells can be transformed after infection by ultraviolet light-irradiated herpes simplex viruses type 1 (HSV-1) or type 2 (HSV-2). Two of 12 strains of HSV-1 and 7 of 15 strains of HSV-2 induced cell transformation. Transformed cells from two strains of HSV-2 and one strain of HSV-1 were tested for oncogenicity in newborn Syrian hamsters. One cell line transformed by HSV-2 strain 333 was found to be oncogenic. The remaining two cell lines were not oncogenic. Herpesvirus antigens were found in the cytoplasm and on the surface of the transformed cells. Neutralizing antibodies were produced in hamsters developing tumors after the injection of the HSV-2-transformed cells. Weanling hamsters that were preimmunized by injection of HSV-1 or HSV-2 did not develop transplantation immunity to the HSV-2-transformed cells as a result of this preimmunization. HSV-2-transformed cells metastasized after injection into hamsters. The number of metastases was not inhibited by HSV-1 or HSV-2 immunization but was actually enhanced. Immunization of hamsters with simian virus 40 inhibited metastases but did not reduce the rate of primary tumor development. (auth)

5298 DRUG MODIFICATION OF POST-ULTRAVIOLET SURVIVAL IN DNA DARK REPAIR MUTANTS OF ESCHERICHIA COLI. Lankford, J. C. III. Birmingham, AL; Univ. of Alabama (1972). 85p. University Microfilms Order No. 73-27,271.

Thesis (Ph. D.).

The effects of mutagenic and non-mutagenic acridines and ethidium bromide on post-irradiation survival of DNA repair mutants of Escherichia coli were investigated. Mutagenic acridines (9-aminoacridine hydrochloride and acridine orange) as well as ethidium bromide were inhibitors of dark repair in E. coli B, and the non-mutagenic acridine, 10-methylacridinium chloride, did not inhibit dark repair. A positive correlation was found between the relative mutagenicity of the acridines and their ability to inhibit dark repair, i.e., strong mutagens were strong repair inhibitors. The effects of 9-aminoacridine hydrochloride were also studied in E. coli B/r, a radiation resistant strain and E. coli B_s-1 a uv sensitive organism. In E. coli B/r, 9-amino-

acridine hydrochloride inhibited dark repair at the same concentration that inhibited E. coli B. The drug had no effect on the post ultraviolet survival of E. coli B_s-1. Since this organism lacks the incision step of repair, which means the dark repair is never initiated, its lack of response to acridines was as expected. This was taken as additional evidence that dark repair was the process being inhibited by the drugs in E. coli B. E. coli ts-7, a mutant of E. coli TAU-bar with a temperature sensitive ligase enzyme, was used to determine if the ligase step of dark repair was the site of inhibition by acridines. The effective drug concentration for these organisms was 10 times that required for inhibition in E. coli B. Experiments on the effect of 9-aminoacridine hydrochloride on repair in E. coli ts-7 demonstrated that the ligase enzyme was not the enzyme specifically inhibited by the drug. Control experiments using E. coli TAU-bar required the same drug concentration for inhibition as E. coli ts-7 and showed the same degree of inhibition by the drug of post-uv survival. Thus, a model for the regulation of dark repair in E. coli dark repair mutants was proposed in which the major role of acridines in frameshift mutations was directly related to inhibition of dark repair. This inhibition may be due to the drug effect either on the overall repair process or on a single enzymic step of repair. The studies with E. coli ts-7 eliminated the ligase step as the single step of repair inhibition. Acridines may bind to DNA by means of intercalation. However, intercalation might be essential but not sufficient for acridine inhibition of dark repair. After binding to DNA, the lack of specific blocking groups, i.e., methylation, on the ring nitrogen of the mutagenic acridines allows them to inhibit selectively the function of repair enzymes. Although non-mutagens bind DNA to the same extent, they have a methyl group blocking the nitrogen in the acridine ring that allows the repair process to proceed unimpeded. (Diss. Abstr. Int., B)

5299 ASSAY OF STRONTIUM-90 IN HUMAN BONE IN THE UNITED KINGDOM. Results for 1970. Monitoring Report No. 19. London; Her Majesty's Stationery Office (1973). 22p. (NP-19879). Dep. NTIS (U. S. Sales Only) $3.00. UK 23½ pence.

Data are reported for UKAEA assays of radioactive and natural strontium in human bone and Glasgow assays of radioactive strontium in human bone during 1970. Tables are presented to show summaries of ^{90}Sr values for 1969 and 1970 following various surveys. (HLW)

5300 SYNERGISTIC INTERACTIONS BETWEEN RAD MUTATIONS IN YEAST. Game, J. C.; Cox, B. S. (Botany School, Oxford). Mutat. Res.; 20: No. 1, 35-44 (Oct 1973).

UV-survival data are presented for haploid yeast strains carrying mutations in two or more rad genes. Some of these mutants are not, by themselves, very sensitive to uv-light but nevertheless show a strong synergistic interaction with other uv-sensitive mutants. It is proposed that such synergism arises when mutations block two repair pathways each acting on a common substrate. Multiple-mutant strains were used for exposing interactions between mutants that only become fully expressed in an excisionless genetic background. The results indicate that the seven genetic loci studied mediate three different types of recovery from uv irradiation. (auth)

5301 INDUCTION OF DOMINANT LETHALITY BY X RAYS IN A RADIOSENSITIVE STRAIN OF YEAST. Ho, K. S. Y.; Mortimer, R. K. (Univ. of California, Berkeley). Mutat. Res.; 20: No. 1, 45-51 (Oct 1973).

X-ray-survival curves of haploid, diploid, triploid, and tetraploid yeast strains homozygous for the x-ray-sensitive mutation rad52 (previously xs1) are presented. These curves suggest that strains carrying the rad52 mutation may be more susceptible than wild type to x-ray-induced dominant lethal damage. For the crosses (+×+, rad52 × rad52, +× rad52, rad52 ×+) in which only one parent was irradiated, the relationships between zygote survival and x-ray dose were similar except for rad52 × rad52. In this cross a considerably higher frequency of dominant lethal damage was observed. This observation indicates that the rad52 mutant lacks a repair system for x-ray damage and is consistent with the proposal that unrepaired chromosome damage is the event that leads to dominant lethality and reproductive cell death. (auth)

5302 YEAST STRAIN FOR VISUAL SCREENING FOR THE TWO RECIPROCAL PRODUCTS OF MITOTIC CROSSING OVER. Zimmermann, F. K. (Brooklyn Coll.). Mutat. Res.; 21: No. 5, 263-269 (Oct 1973).

A strain of Saccharomyces cerevisiae, D_5, is described that allows for rapid, visual screening for mitotic crossing over in colonies on solid media. D_5 carries two phenotypically distinguishable and recessive alleles of the gene ade2. One allele, ade2-119, causes a leaky requirement for adenine, and a pink coloration of colonies. The other allele, ade2-40, causes a complete requirement for adenine and the formation of deeply red colonies. The two alleles complement each other to the effect that D_5 forms white colonies and does not require adenine for growth. Mitotic crossing over generates two reciprocal products that show up together in colonies as pink and red sectors, twin-spotted colonies. Such twin-spotted colonies were obtained after treatment with ultraviolet light, γ rays, and ethyl methanesulfonate (EMS). Tetrad analysis was performed with cells isolated from the red and the pink half of twin-spotted colonies. The results showed that the pink sectors had become homozygous for allele ade2-119, the red sectors were homozygous for the other allele, ade2-40. With one exception, other markers present in D_5 in a heterozygous condition were still heterozygous. In addition to twin-spotted colonies, colonies with white and red or white and pink and even with red, white and pink sectors as well as completely pink or completely red colonies were found. These can be interpreted to result from a variety of mechanisms other than mitotic crossing over that are mentioned in the discussion. (auth)

5303 BIOLOGICAL INDICATORS AND THE EFFECTIVENESS OF STERILIZATION PROCEDURES. Macek, T. J. pp 19-34 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

A discussion is presented of the measurement of death and survival of microorganisms following sterilization treatments with steam, dry heat, and gases such as ethylene oxide, propylene oxide, and formaldehyde. Direct and indirect effects of ionizing radiation on microorganisms are discussed. The relationship of the medium, temperature, concentration of solutes, pH, and gases of the environment to the indirect action of radiation is discussed. The dose of radiation required to sterilize medical devices, drugs, and biomedical products is considered. Bacteria used as biological indicators include Bacillus subtilis, B. pumilus, and Micrococcus radiodurans. (HLW)

5304 BIOLOGICAL CONTROL OF INDUSTRIAL GAMMA RADIATION STERILIZATION. White, J. D. M. pp 101-116 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

Microbiological control of radiation sterilization is discussed with regard to three stages in the manufacture of a sterile item: presterilization, sterilization, and post sterilization. The discussion of presterilization control considers initial contamination counts as an indication of the likely average level of microbial contamination. The RBE of the radiosterilization plant is discussed as a part of presterilization control. In the discussion of sterilization control two basic types of biological indicators are considered: inoculated carriers and inoculated products. The function of both types is to measure the desired dose of radiation absorbed during sterilization. During poststerilization control the product is sterility tested after sterilization. Limitations on the information obtained from sterility testing are discussed. (HLW)

5305 AEROSPACE RESEARCH: APPLICATIONS TO INDUSTRIAL STERILIZATION. Brewer, J. H. (National Aeronautics and Space Administration, Washington, DC). . pp 299-303 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

The question of the existence of life on other planets in relation to aerospace research is discussed. It is pointed out that ultraviolet radiation is lethal for all cells and tissues, but that a thin protective layer will protect the cells against ultraviolet radiation. The importance of ionizing radiation at doses found in space in inducing mutations and death of cells is discussed. Reviews are presented of space exploration research and its effects on space biology. (HLW)

5306 SYNERGISTIC INACTIVATION OF BIOLOGICAL SYSTEMS BY THERMORADIATION. Sivinski, H. D.; Garst, D. M.; Reynolds, M. C.; Trauth, C. A. Jr.; Trujillo, R. E.; Whitfield, W. J. (Sandia Labs., Albuquerque, NM). pp 305-335 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From International symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

When Bacillus subtilis spores were treated with heat, gamma radiation, and combinations of heat and radiation, there was a greater degree of inactivation with the combined treatments. When pulsed x rays were used in combination with heat, there was also an increased inactivation. The enzyme activity of

lysozyme was determined after exposure to heat, radiation, or thermoradiation by assaying the ability of lysozyme to lyse Micrococcus lysodeikticus cell walls; the combined heat and radiation caused a synergistic loss of enzyme activity; advantages of thermoradiation in industrial sterilization are listed. (HLW)

Radiation Effects on Plants

Refer also to abstract 5305.

5307 (BNL-18250) RELATION BETWEEN MUTATION YIELD AND CELL LETHALITY OVER A WIDE RANGE OF X RAY AND FISSION NEUTRON DOSES IN MAIZE. Smith, H. H.; Rossi, H. H.; Kellerer, A. M. (Brookhaven National Lab., Upton, N. Y. (USA); Columbia Univ., New York (USA)). 1973. 17p. (CONF-731038-3; SM-179/28). Dep. NTIS $3.00.

From effects of neutron irradiation upon cell function; Neuherberg, F. R. Germany (22 Oct 1973).

Seeds of maize were exposed to x rays at a dose rate of 1658 to 1845 rad/min; other seeds were exposed to fission neutrons at a dose rate of 27.5 to 198 rad/min. The irradiated seeds and controls were sown in moist soil. When mature the fourth and fifth seedling leaves were harvested and scored for frequency of yellow-green sectors. Tables and graphs are presented to show dose-response data for frequency of yellow-green sectors per leaf, frequency of mutations as a function of absorbed dose, neutron-induced yield of mutations and RBE of neutrons in comparison to x radiation. (HLW)

5308 (BNL-18266) INFLUENCE OF EXPERIMENTAL END POINTS, DOSE, DOSE RATE, NEUTRON ENERGY, NITROGEN IONS, HYPOXIA, CHROMOSOME VOLUME AND PLOIDY LEVEL ON RBE IN TRADESCANTIA STAMEN HAIRS AND POLLEN. Underbrink, A. G.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 36p. (CONF-731038-1; SM-179/31). Dep. NTIS $4.00.

From effects of neutron irradiation upon cell function; Neuherberg, F.R. Germany (22 Oct 1973).

Procedures are described for irradiating Tradescantia cuttings with neutrons and x rays. Stamen hairs were scored for various mutations. Results are discussed under the following headings: experimental end points and RBE; influence of dose on RBE; effect of dose rate on RBE; influence of neutron energy on RBE; the RBE of 3.9 GeV nitrogen ions; the influence of hypoxia (OER); and the influence of chromosome volume and ploidy level on RBE; pollen abortion data. Graphs are presented to show survival curves for stamen hairs after neutron and x irradiation and neutron and x-ray dose-response curves for pink mutants, blue giant cells, and colorless mutants. (HLW)

5309 EFFECT OF GAMMA RAYS ON THE ULTRASTRUCTURE OF RYE CELLS (SECALE CEREALE L.). Ciobanu, R. I. Rev. Roum. Biol., Ser. Bot.; 17: No. 3, 151-156(1972). (In French).

The ultrastructural effects of gamma rays in doses of 30,000 R on cell organelles of diploid rye caryopses are discussed. A comparative study was made of the ultrastructure of meristem cells obtained from the germination of nonexposed caryopses and the ultrastructure of ^{60}Co-irradiated caryopses meristems germinated right after irradiation or after the lapse of one year since exposure. Observations were made on the Siemens electron microscope. (ERB)

5310 MUTATION OF THE CITRUS VARIETY TACHIMA-WASE INDUCED BY X RAYS. Watanabe, H. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 8-12(Jan 1973).

Young plants of citrus variety Tachima-wase were irradiated by x rays at 500, 1000, 1500, 2000, 2500, 3000, 4000, and 5000 R. Dormant buds of trees irradiated at more exposures than 1000 R come out considerably later than control, and the reduction in shoot growth was more severe with increased exposure. Typical abnormalities in leaves of irradiated trees were observed in early sprouts. Percentage of deformed leaves increased with increasing exposure. X-rays induced a vigorous mutant. Five years after irradiation, the mutant bore 10 flowers and showed parthenocarpy. The fruit of the mutant tends to be rich in free acids. The experimental results suggest that the mutation induction by x rays has a considerably high possibility in citrus. (auth)

Radiation Effects on Animals

Refer also to abstract 6750.

Man

Refer also to abstracts 7083 and 7472.

5311 (LA-UR-73-1331) POSSIBLE PION SOURCES FOR RADIOTHERAPY. Knapp, E. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 4p. (CONF-731030-3). Dep. NTIS $3.00.

From second meeting on fundamental and practical aspects of the application of fast neutrons in clinical radiotherapy; The Hague, Netherlands (3 Oct 1973).

Recently great interest has been shown in pi-meson irradiation as a possible modality for cancer radiation therapy. In order for this short-lived particle to be more than an idle laboratory curiosity, it must be demonstrated that economical pion sources can be built, which satisfy the necessary flux requirements for therapy within reasonable space and cost limitations. Protons have a much higher probability for producing pions per unit target mass than do electrons, so if there were no other consideration it is clear that proton accelerators would be superior to electron accelerators as pion sources. Unfortunately, proton accelerators are considerably more difficult to build than electron accelerators, requiring more precise control, more rf power, and probably more length than their counterparts. At 500-MeV the advantage of protons over electrons for production is about a factor of 50, that is, for the same total yield of pions, an electron accelerator must have 50 times the beam power required of an equivalent proton machine. One possible way around this problem is to design a much more efficient magnetic channel to collect the pions and focus them on the patient being treated. Such a system has been designed that utilizes 60 parallel magnetic spectrometers to focus a total of $^1/_{12}$ the total pions produced in the pion production target on the patient. This system requires a more sophisticated control system, but is certainly an indicator of a direction to go to reduce source cost. This approach also reduces the beam current requirements on a proton accelerator by a factor of 30 making a 30 microamp accelerator a possibility. A brief description of four accelerator systems that might be suitable for hospital use, two electron accelerators, and two proton accelerators, is given to illustrate the problems involved. (CH)

5312 (RD/B/N-2647) USE OF LEAD LOADED RUBBER GAUNTLETS IN MIXED BETA-GAMMA RADIATION FIELDS. Charles, M. W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

The effect on skin dose of wearing lead-loaded rubber gauntlets in a γ-radiation field was evaluated experimentally using ^{60}Co and ^{137}Cs radiations. The results are used to indicate the usefulness of the gauntlets for β shielding applications in a mixed β,γ environment. A general analysis of the physical processes giving rise to dose variations at the interface between different media is presented as an appendix. (auth)

5313 POSTIRRADIATION CERVICAL MYELOPATHY SIMULATING SPINAL CORD TUMOR. Carvalho, R. R. D.; Brandt, R. A.; Stecca, J. (Faculdade de Ciencias Medicas da Santa Casa, Sao Paulo, Brazil). Arq. Neuro-Psiquiat; 30: 340-347(Dec 1972). (In Portuguese).

The clinical and pathological studies of a post-radiation cervical myelopathy in a 25-year-old male are reported. The patient had received 6,000 R at the neck region for an undifferentiated carcinoma of the pharynx with metastasis to lymph nodes. Six months later progressive tetraparesis developed, and myelography suggested intramedullary tumor. Post-mortem examination showed radiation cervical myelopathy. (auth)

5314 MANAGEMENT OF UNPREVENTABLE SIDE EFFECTS OF MEGAVOLT THERAPY IN PRACTICE. Werner, G. T. (Univ., Muenchen, Ger.); 111: 1570-1576; 1578; 1581-1583; 1586(Nov 1972). (In German).

The management of side effects occurring after megavolt therapy is discussed. Certain procedures are recommended for the treatment of skin reactions including radioinduced ulcers, and for complications after radiotherapy of pharyngeal and laryngeal tumors. Irradiation of inoperable bronchial carcinoma necessitates medication for the support of circulation, respiration, expectoration, and the suppression of coughing and infection. Also discussed is the treatment of side effects in the urinary tract, rectum, spinal cord, and brain. Several procedures are recommended for the handling of initial reaction, anemia, and pain. (HBG)

5315 EXPERIMENTAL INVESTIGATION ON DENTAL X-RAY SETS. Castagna, R.; Sarandrea, M.; Venier, A. (Ente Nazionale Prevenzione Infortuni, Monte Porzio Catone, Italy). Securitas; 57: No. 7, 585-592(1972). (In Italian).

An experimental checkup of the security levels of some apparatuses for dental radiography in Rome and its environment was carried out. The majority of the apparatuses examined were found to have faults causing the delivery of unnecessary overdoses to patients and/or staff. Adequate correcting measures were

suggested. The necessity of strict regulations for the safety of dental radiography equipment is emphasized. (INIS)

5316 MEANS AND PERSPECTIVES OF DEVELOPMENT OF HYGIENE IN WORK USING RADIOACTIVE SUBSTANCES AND SOURCES OF IONIZING RADIATION. Lyarskii, P. P. Gig. Sanit.; 6: No. 1, 55-59(Jun 1973). (In Russian).

The work of the Institute of Industrial and Professional Health of the USSR Academy of Medical Sciences is outlined. This institute is the center and coordinator of studies in radiation protection, which it started in 1945. Studies have run the gamut of radiation protection work and have included: (1) evaluation of working conditions and clinical manifestations of the action of radiation alone or in combination with other working conditions; (2) evaluation of the effects on the organism of chronic exposure to small doses of radiation; (3) development of better methods for quantitative measurement of subclinical doses or radiation to critical organs; and (4) new means of protection against radiation. (TTT)

5317 OSTEORADIONECROSIS OF JAWS AFTER IRRADIATION WITH COBALT-60 TELEGRAMMATHERAPY. Kopec, V.; Tomasek, J.; Beska, F. Cesk. Stomatol.; 71: No. 3, 159-162 (1971).

Three out of 68 patients (4.41%) developed osteoradionecrosis of the lower jaw and total irradiation dental caries following irradiation with ^{60}Co for malignancies of the oral cavity, jaws, and neck. Teeth left in the irradiated region of the jaw are a permanent danger as a possible future cause of acute spreading of bone radionecrosis. The etiology, pathogenesis, and therapy of three cases of osteoradionecrosis of the lower jaw are described. (ERB)

5318 SCINTILLATION IMAGING IN GENERALIZED AND LOCALIZED RADIATION NEPHRITIS. Schulman, N.; Johnson, P. M. (Columbia Univ., New York). Radiology; 109: No. 3, 639-642(Dec 1973).

Two cases of radiation-induced injury of normal kidney resulting in generalized or localized nephritis are presented. The generalized nephritis follows irradiation of the entire organ and may be associated with intractable hypertension. Localized nephritis results from irradiation of only part of the kidney and may be asymptomatic. Scintillation imaging provides a sensitive means to detect, differentiate, and follow both types of radiation nephritis. (auth)

5319 CLINICAL EXPERIENCE OF CGC TABLET (CYSTEINE, VITAMIN C) IN THE PATIENTS TREATED WITH RADIATION. I. Kinoshita, F.; Maekawa, Z. (Tokyo Metropolitan Hospital, Okubo, Japan). Shinryo To Shinyaku; 10: No. 3, 557-567(Mar 1973). (In Japanese).

Three tablets of CGC, which is a mixture of cysteine and vitamin C, were given orally three times a day to the patients with malignant neoplasms immediately before irradiation. Reduction of side effects is discussed. As side effects, subjective symptoms, blood findings, liver function test, and effects on therapeutic response were observed. Diseases of the patients (a total of 27 cases) were as follows: eight cases of breast cancer, seven of cervical uterus cancer, three of eosophagus cancer, two of myoma uteri, and each one case of lung cancer, penis cancer, brain neoplasms, duodenum cancer, rectal cancer, osteosarcoma of the pelvis, and orchis cancer. The mean leukocyte count dropped from 5500 before irradiation to 4600 after irradiation. There were two cases of which leukocyte count was less than 3000, but its count recovered more than 4000 in ten days after termination of irradiation. The mean red blood cell count increased from 3,440,000 before irradiation to 3,480,000 after irradiation. The mean amount of hemoglobin increased from 75% before irradiation to 76% after irradiation. There was no case in which examination results of liver function test before irradiation took a bad turn after irradiation. All 27 cases were given prearranged dose within a fixed period, and expected effects of radiotherapy were obtained. Furthermore, symptoms and treatment progress of each case administered with CGC were explained. (JA)

5320 APPLICATIONS OF CYCLOTRONS. Watanabe, T. (Tokyo Univ.). Genshiryoku Kogyo; 19: No. 7, 11-15(Jul 1973). (In Japanese).

The present state of the treatment of malignant tumors by fast neutrons and the production of short-lived radioisotopes by use of a medical cyclotron are described. Fast neutrons are much more effective on cells without oxygen in the tumors than x rays or γ rays, and application of it to gastric cancer is expected. In addition to beryllium, which has been already used as a target, heavy water, ^{7}Li, ^{8}Be, ^{9}Be, ^{12}O, and ^{12}C are to be examined. ^{68}Ga, ^{18}F, ^{132}I, ^{87m}Sr, ^{99m}Tc, ^{137m}Ba and ^{113m}In are produced by the cyclotron with a clinically adequate half-life. ^{15}O, ^{13}N, and ^{18}F are also expected to be used, as short-lived radioisotopes. Conditions for producing radioisotopes are that: solid, fluid, or gas is available to target; high beam current is available; cooling of target is established; and unnecessary exposure is avoided by automatic exchange of target. The efficiency of radioisotopes production by the CS-22 cyclotron is illustrated. Cost and machine time are studied. The characteristic of large-sized cyclotron for treatment by proton is to irradiate the tumor region concentrically than the surroundings. In Japan, a large-sized cyclotron with changeable energy is under preparation at National Institute of Radiological Sciences, and the treatment of malignant tumor by fast neutron and the production of short-lived radioisotopes are in practical use. (JA)

5321 DOWN'S SYNDROME WITH 47,XX,+21-47,XX,+MAR MOSAICISM. Weber, F. M.; Sparkes, R. S.; Muller, H. (Univ. of California, Los Angeles). J. Med. Genet.; 10: 177-179(Jun 1973).

A four-year-old girl with typical Down's syndrome is described. She has 47,XX,+21 karyotype in skin and lymphocytes and 47,XX, +mar karyotype in some lymphocytes. Autoradiography and fluorescent analyses have failed to identify the +mar chromosome that has the appearance of a D chromosome but which may involve a translocation to a chromosome No. 21. However, the mechanisms of its formation and its significance are not certain. (auth)

5322 HEPATITIS-ASSOCIATED ANTIGEN IN ATOMIC BOMB SURVIVORS AND NONEXPOSED CONTROL SUBJECTS: SEROEPIDEMIOLOGIC SURVEY IN A FIXED COHORT. Belsky, J. L.; King, R. A.; Ishimaru, T.; Hamilton, H. B.; Nakahara, Y. (Japanese National Inst. of Health, Hiroshima). J. Infect. Dis.; 128: No. 1, 1-6(Jul 1973).

A survey to determine the prevalence rate of hepatitis-associated antigen (HAA) was carried out among 6,577 atomic-bomb survivors and controls in Japan. The overall prevalence rate of positive cases, determined by the micro-Ouchterlony technique, was 0.68%, a rate similar to that of Tokyo blood donors, and about fivefold higher than ambulatory persons in the United States and northern European countries. Younger subjects (20 to 29 years) of both sexes showed the highest rates, and a trend toward higher rates during the spring and summer was noted. History of liver disease, injections and vaccination within 12 months, acupunctures within six months, or ingestion of raw shellfish were not more prevalent among subjects with positive HAA responses. A significant relationship was shown between positive cases and a history of multiple blood transfusions. There was no statistically significant relationship between antigenemia and exposure to the A-bomb. Higher values for serum glutamic-pyruvic transaminase activity and thymol turbidity tests were noted among those who were HAA positive compared with those who were HAA negative. However, these are differences in distribution only, since there are no significant increases in rate of HAA among those who had abnormal values for liver function tests. (auth)

5323 BLOOD COAGULATION IN PATIENTS WITH TOXIC GOITER. Panchenko, V. M.; Antonidze, A. V. Probl. Endokrinol.; 19: No. 5, 22-27(1973). (In Russian).

Data are presented on the study of blood coagulation in 128 patients with toxic goiter—mild, moderately severe, and severe forms before and after mercazolyl (mild) and ^{131}I (moderately severe and severe) treatment. Signs of reduction of blood coagulative activity and an increase of fibrinolytic activity, and heparin, which elevated in parallel with the clinical severity of the disease were revealed in the patients with toxic goiter before the beginning of the treatment. Following prolonged mercazolyl therapy blood coagulative capacity in patients with toxic goiter increased; at the height of ^{131}I action signs of hypocoagulation became elevated; this was confirmed by parameters of thromboelastography, a reduced content of fibrinogen, of fibrin-stabilizing factor, and increased heparin content, a high fibrinolytic activity, and a rise of urinary urokinase. Coagulative blood potential increased considerably, heparin fell, and urokinase and fibrinolytic activity decreased after recovery from toxic goiter. (auth)

5324 CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES AFTER X IRRADIATION IN VITRO. II. Analysis of Primary Processes in the Formation of Dicentric Chromosomes. Bauchinger, M.; Schmid, E. (Univ., Munich). Mutat. Res.; 20: No. 1, 107-113(Oct 1973).

The rejoining distance for the formation of dicentric chromosomes in human lymphocytes was derived on the basis of microdosimetric concepts. For the formation of a dicentric chromosome, primary lesions produced by absorption events can interact within the nucleus over a distance of at least 1 μm. The dispersion of dicentrics is near to 1 and corresponds to a site number between 17 and 120. (auth)

5325 RADIOLOGICAL PROTECTION AND LEGISLATION. Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 111-118(Apr 1973). (In French).

The official organizations concerned with radioprotection are presented. The principal current legislation is cited. (FR)

5326 LOW-LEVEL IRRADIATION EFFECTS ON MAN. Casarett, G. W. (Univ. of Rochester, NY). Trans. Amer. Nucl. Soc.; 17: 11-12(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5327 CALCULATED BODY-DISTRIBUTED DOSES FROM A GAMMA-RAY BRAIN SCALPEL. Cohen, M. O.; Lichtenstein, H. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 99-100(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5328 RELATIVE MORTALITY EFFECTS OF RADIATION AND AIR POLLUTION. Rogers, V. C. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 409-410(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Vertebrates

Refer also to abstracts 5305 and 7473.

5329 (CEA-N-1651) CHANGES OF ARTERIAL BLOOD PRESSURE, HEART RATE, INTERNAL BODY TEMPERATURE, AND BLOOD ACIDO-BASIC BALANCE IN THE UNANAESTHETIZED RABBIT FOLLOWING WHOLE-BODY GAMMA IRRADIATION AT A MEAN ABSORBED DOSE OF 250 RADS. Dufour, R.; Court, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Sep 1973. 43p. (In French). Dep. NTIS (U.S. Sales Only) $4.25.

The general effects of whole-body γ-irradiation at a mean absorbed dose of 250 rads were studied simultaneously in the unanaesthetized rabbit for 48 hours. They occurred early, with the following characteristics: arterial blood pressure decreased steadily as early as the 2nd hour and reached its minimum value on the 5th hour with a decrease of about 14%; it remained low during the following two days. Heart rate increased during the first hour, was the highest by the end of the second hour, and resumed normal value on the 24th hour. Internal body temperature increased during the 1st hour and was maximum by the end of the 2nd hour, with a mean increase of 1.2°C; hyperthermia steadily decreased between the 4th and the 6th hours and had completely disappeared by the 24th hour. Respiratory alkalosis is shown in the acido-basic balance by a raise of pH, a decrease of PCO_2 and arterial blood bicarbonates. These various changes seem to indicate a double origin, both central and peripheral. (FR)

5330 (CONF-730730-1) RELEVANCE OF PHOTOBIOLOGICAL REPAIR. Setlow, R. B. (Tennessee Univ., Oak Ridge (USA). School of Biomedical Sciences; Oak Ridge National Lab., Tenn. (USA)). 1973. 23p. Dep. NTIS $3.25.

From symposium on new trends in photobiology; Rio de Janeiro, Brazil (15 Jul 1973).

A review is presented of photobiological and photochemical studies in relation to radiation damage and repair. Some topics discussed are: repair of damage induced in DNA by ultraviolet and gamma radiation; the repair of chemically induced damage to DNA; uv-induced skin cancer; enzymic photoreactivation of uv-irradiated DNA; and photoreactivation of uv-induced tumors in fish. (HLW)

5331 (UCSF-10-P-2-213) RBE OF NEUTRONS IN VIVO. Karen, K. F.; Phillips, T. L.; Rowe, J. R. (California Univ., San Francisco (USA)). 1973. 24p. (CONF-731040-1). Dep. NTIS $3.25.

From American Society of Therapeutic Radiologists meeting; New Orleans, Louisiana, USA (25 Oct 1973).

The potential for neutrons in radiation therapy depends on a differential in RBE for tumor versus normal tissues. To study this the responses of normal and tumor tissues to 15-MeV and ^{252}Cf neutrons were compared with responses to ^{137}Cs gamma or 300 KVP x rays in the mouse in vivo. Using 1% survival as a biological end point, the PBE's of 15-MeV and ^{252}Cf neutrons are 2.29 and 5.13 (^{137}Cs at 4.5 rads/min) respectively for the EMT6 tumor and 1.48 and 2.45 (^{137}Cs at 4.5 rads/min) respectively for bone marrow CFU's. For pulmonary and esophageal lethality, the RBE values of 15-MeV neutrons are 2.24 and 4.08. With 15-MeV neutrons, the RBE for the tumor is greater than the bone marrow CFU. The RBE for pulmonary lethality is less than that for esophageal lethality. With ^{252}Cf, the RBE for the EMT6 tumor, although greater than the bone marrow CFU, is not significantly different from reported in vivo RBE values of normal tissues at comparable gamma dose rates. (auth)

5332 (UR-3490-379) QUANTITATIVE HISTOPATHOLOGY IN RELATION TO RADIOSENSITIVITY AND RESPONSE: EXPERIMENTAL CANCERS IN A COMMON TRANSPLANT SITE. Casarett, G. W.; Eddy, H. A.; Nelson, J. M. (Rochester Univ., N.Y. (USA). School of Medicine and Dentistry). 1973. 47p. (CONF-730965-1). Dep. NTIS $4.50.

From 9th annual West Coast Cancer Symposium; San Francisco, California, USA (14 Sep 1973).

A review is presented of studies on the effects of radiation on tumors. Emphasis is placed on the effects of oxygen on radiosensitivity and the advantages of fractional radiation in radiotherapy are discussed. Experiments are described in which sarcomas and carcinomas from the golden hamster were transplanted into cheek pouches for comparative studies and a detailed procedure for quantitative histological studies is outlined. Effects of x radiation on the mitotic activity of tumor cells were studied using tritiated thymidine as a tracer. X radiation of tumors growing in the cheek pouch was localized to the tumor in the everted pouch. Results are presented under the following headings: quantitative histology of non-irradiated sarcomas; control of sarcomas by brief single x-ray exposure; and histologic analysis of briefly irradiated sarcomas. A point-hit analysis of irradiated reticulum cell sarcoma showed that there was a small reduction in tumor cell hits, a sizeable reduction in debris hits, and sizeable increases in stromal and space hits. Studies were made on mitotic and necrotic cell indices after small, fraction-size radiation exposures. (HLW)

5333 BONE MARROW SYNDROME AFTER LETHAL WHOLE BODY IRRADIATION IN THE DOG. Part 1. Quantitative and Qualitative Analysis of the Peripheral Blood and Bone Marrow Cellularity. Louwagie, A. C.; Waes, J. A.; Van Vuchelen, J.; Verwilghen, R. L. (Lab. for Physiopathology, Leuven, Belg.). Haematologia (Budapest); 5: No. 1-2, 67-78(1971).

The bone marrow syndrome was investigated in dogs subjected to 400 R whole-body irradiation. Hematological and morphological examinations of peripheral blood revealed progressive pancytopenia. After the early disappearance of the youngest nucleated bone marrow cells, the bone marrow cellularity dropped to a low level in 5 days and remained constant till death. Quantitative data obtained in the first 24 hrs after irradiation showed an immediate and nearly complete impairment of hematopoiesis with the normoblasts having the highest radiosensitivity. An increase in the normoblast, lymphocyte, reticulum cell, and plasmocyte counts was observed after 6 days, while the number of myeloid cells decreased further. The increase suggested a tendency to recovery in the preterminal phase. A relation may exist between the increase of the lymphocyte and reticulum-like cell counts and hematological recovery. (INIS)

5334 SYNTHESIS OF IgM AND IgG ANTIBODIES IN MICE IRRADIATED WITH X RAYS AND IMMUNIZED WITH TETANUS TOXOID. Galazka, A.; Albrycht, H.; Aleksandrowicz, J.; Gajewski, A. K.; Grzymala, W. J. (Panstwowy Zaklad Higieny, Warsaw). Med. Dosw. Mikrobiol.; 24: 255-265(1972). (In Polish).

White mice were immunized with adsorbed tetanus toxoid 1 to 2 hrs following irradiation with a dose of 300 R. The antibody response was tested in whole sera 7, 14, 28, and 42 days after immunization; it was found to be delayed and repressed compared with controls. In tests for antibody activity of different classes of immunoglobulins, isolated on Sephadex G-200, the IgM-producing mechanisms were found to be highly radiosensitive; peak of the response was greatly delayed (28 days); and peak titers were threefold lower than in controls. IgG antibody production also was delayed and in the initial period it was repressed. Six weeks after irradiation, IgG antibody levels were equal in the irradiated and control mice. The present results concerning radiosensitivity of IgM-producing mechanisms are discordant with data of other authors, who immunized animals with other antigens or investigated the metabolism of immunoglobulins in irradiated but non-immunized animals. (auth)

5335 EFFECT OF WHOLE-BODY IRRADIATION WITH X RAYS ON THE FORMATION OF IMMUNITY IN TETANUS TOXOID-IMMUNIZED MICE. Part 2. Secondary Immunity to Tetanus Toxin. Galazka, A.; Albrycht, H.; Gajewski, A. K.; Grzymala, W. J. (Panstwowy Zaklad Higieny, Warsaw). Med. Dosw. Mikrobiol.; 24: 247-253(1972). (In Polish).

White mice were twofold immunized with various doses of adsorbed tetanus toxoid and irradiated with a dose of 500 R at

various time intervals before and after the second immunization. The secondary response of the animals was more resistant to irradiation than the primary one. It was found, however, that antibody synthesis was disturbed in mice irradiated 1 to 2 hrs prior to the second immunization. The detrimental effect of irradiation was found to depend to a high extent on antigen dose used for the first, and not the second, immunization. (auth)

5336 BONE MARROW SYNDROME AFTER LETHAL BODY IRRADIATION IN THE DOG. Part 2. Iron Kinetics. Louwagie, A. C.; Waes, J. A.; Van Vuchelen, J.; Verwilghen, R. (Lab. for Physiopathology, Leuven, Belg.). Haematologia (Budapest); 5: No. 1-2, 79-85(1971).

Studies of iron kinetics in heavily irradiated dogs showed an immediate and severe impairment of hematopoiesis. The marked rise of the serum iron level observed on the first day after irradiation could be due to a decreased iron utilization but may also be ascribed to iron liberated from the destroyed normoblasts. Plasma iron clearance time increased after the irradiation, indicating a heavily disturbed iron metabolism. Plasma iron turnover, in contrast with the increase of plasma iron clearance and the low iron utilization, remained relatively high in the dogs that had received the iron 24 hrs after irradiation. This may indicate that a large amount of the iron removed from the blood is not used for efficient erythropoesis. In the dogs that had received the ^{59}Fe 24 hrs after irradiation, iron utilization on the 9th day was in good agreement with the bone marrow cellularity 24 hrs after irradiation. In view of the fast bone marrow depopulation, the high iron utilization in the group of dogs that received ^{59}Fe 6 hrs before irradiation shows that a great amount of the iron must be incorporated by the smaller number of surviving normoblasts and the more mature normoblasts and reticulocytes that are less radiosensitive and leave the bone marrow soon. (INIS)

5337 CYTOGENETIC EFFECT OF INSTANTANEOUS AND FRACTIONATED X-RAY RADIATION ON MICE MARROW CELLS. Gogebashvili, N. K.; Tarasov, V. A. (Inst. of General Genetics, Moscow). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 1, 189-192 (Jul 1973). (In Russian).

The results of a study of the effect of small doses of single and fractionated radiation on mice marrow cells under exposure to x-rays in vivo and the long-term consequences with respect to chromosome aberrations are discussed. (auth)

5338 CHANGES IN THE PHASE STRUCTURE OF THE CARDIAC CYCLE DURING CONTINUOUS WHOLE-BODY X-IRRADIATION OF RABBITS. Dzhandzhgava, M. M.; Nadareishvili, K. Sh.; Sharashenidze, N. B. (Inst. of Physiology, Tbilissi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 1, 193-196(Jul 1973). (In Russian).

Continuous whole-body exposure of rabbits to a dose of 10 to 15 krads (dose rate 350 to 400 rad per minute) leads to the development of hypodynamia of the phase syndrome of the left ventricle. This effect is preceded by the syndrome of hyperdynamia, which is presumably of compensatory nature. Although these changes appear earlier than the irradiation shock, the available evidence does not warrant the conclusion that the primary radiation injury of the cardiac muscle and its insufficiency constitute the main pathogenic link in the development of the irradiation shock. (auth)

5339 AGING OF CONNECTIVE TISSUE. The Effect of Diet and X Irradiation. Svojtkova, E.; Deyl, Z.; Rosmus, J.; Adam, M. (Health Inst. of Uranium Industry, Prague). Exp. Gerontol.; 7: 157-167(Jun 1972).

The effects of decreased food intake, fat-rich diet, and x radiation were studied. Each of these treatments is known to influence collagen maturation in vivo. It was established that undernutrition retards aging of collagen preferentially when applied to young animals. High fat diet was proved to increase collagen stability, presumably by inducing new hydrophobic contacts. The effect of irradiation is strongly dose-dependent and reflects simultaneously occurring polymerization and depolymerization of the structure. In atherogenic diet-fed animals, ionizating radiation has a predominantly polymerizing effect, which appears to be the result of the conversion of hydrophobic contacts in two other types of bonds. On the tissue level it has been observed that high fat diet causes a pronounced accumulation of collagenous stroma in organs which otherwise exhibit low rate of collagen turnover. (auth)

5340 REACTIVITY TO SOME PSYCHOTROPIC DRUGS IN THE COURSE OF POST-IRRADIATION SYNDROME. Polocki, B. Rocz. Akad. Med. Bialymstoku; 17: 159-177(1972). (In Polish).

The reactivity to some psychotropic drugs such as methedrine, chlorpromazine, hydroxyzine, rezerpine, and phenobarbital in the course of postirradiation syndrome was studied. Experiments were carried out on rats and mice after whole-body x irradiation. The activity of psychotropic drugs was evaluated on the basis of the influence upon the rapidity of forming avoidance-conditioned reflexes in rats and the psychomotoric activity in mice. The level of chlorpromazine was estimated according to the method of Dubois and Pascal. In the course of irradiation sickness the activity of psychodepressive drugs increases while that of psychostimulative drugs decreases. In the blood of the irradiated rats the level of chlorpromazine increases; the time of accumulation of the drug in the brain tissue lengthened. The content of bound chlorpromazine in the brain tissue was greater, and the dialysis rate diminished in the irradiated animals in comparison to the control ones. It means that after irradiation the sorption properties of proteins increase as well as the speed of penetration of chlorpromazine inside the incubated section of brain; it can indicate the increase of the permeability of cell membrane. A supposition was put forward that the increase of the activity of psychotropic drugs was brought about by the elevation of their level in the brain tissue because of the penetration facility, and the lengthened accumulation and slower elimination depended on the greater binding of the drug to the tissue proteins. The diminished action of methedrine implies that some other factors may play a role too. (auth)

5341 (BNL-18225) RAT MAMMARY CARCINOGENESIS FOLLOWING NEUTRON- OR X-RADIATION. Shellabarger, C. J.; Kellerer, A. M.; Rossi, H. H.; Goodman, L. H.; Brown, R. D.; Mills, R. E.; Rao, A. R.; Shanley, J. P.; Bond, V. P. (Brookhaven National Lab., Upton, N. Y. (USA); Columbia Univ., New York (USA). Coll. of Physicians and Surgeons). 1973. 16p. (CONF-731038-2; SM-179/26). Dep. NTIS $3.00.

From effects of neutron irradiation upon cell function; Neuherberg, F. R. Germany (22 Oct 1973).

Sprague-Dawley female rats, 61 to 63 days of age, were given a single dose of either 0.10, 0.40, 1.6, or 6.4 rads of 0.43-MeV neutrons, or 28, 56, or 85 rads of 250-kVp x rays, or no radiation in a single experiment. The interim results, either in terms of percent of rats with mammary neoplasia or mean number of mammary neoplasms per rat, at the end of 14 months after irradiation, indicate that 0.10 to 0.40 neutron rads was followed by a mammary neoplastic response much like that following 28 x-ray rads. The mammary neoplastic response to either 6.4 neutron rads or 56 to 85 x-ray rads was similar. Thus the RBE for neutrons for the induction of mammary neoplasia in the Sprague-Dawley rat is much larger at low neutron doses than at high doses. (auth)

5342 STRUCTURAL ALTERATIONS IN HORSE HEART MYOGLOBIN BY GAMMA RADIATION. Paul, P.; Kumta, U. S. (Bhabha Atomic Research Centre, Bombay). Radiat. Res.; 56: No. 2, 238-245(Nov 1973).

Aggregation of horse heart myoglobin was consistently observed as a function of radiation dose at a concentration of 6 to 8 mg/ml. At 100 krad, 19% of the aggregates was soluble in 6 M urea, while at a higher dose of 500 krad only 8% of the aggregates were soluble. Polyacrylamide gel-disc electrophoresis of the soluble portion indicated the formation of an additional band at 100 krad but there was diffusion of these bands at higher doses. The visible and ultraviolet spectra of the 6 M urea soluble aggregates revealed the presence of the protoprophyrin nucleus as well as the apoglobin moiety. Formation of the aggregates is explained on the basis of the interaction between the parent molecules and the product molecules resulting from radioinduced microheterogeneity. (auth)

5343 DIETARY PROTECTION AGAINST IONIZING RADIATION. Shepherd, D. P.; Brown, S. O.; Krise, G. M.; Crookshank, H. R. (Texas A and M Univ., College Station). Radiat. Res.; 56: No. 2, 282-290(Nov 1973).

One hundred twenty male Wistar rats were divided into three groups of 40 each. One was fed on low potassium-high sodium, another on low sodium-high potassium, and the third a control diet. Half of each group was irradiated with 400 R acute whole-body gamma radiation. A second set of 60 rats was set up as above but given 100 R acute whole-body irradiation. There were significant decreases in body weight in the irradiated rats. The serum sodium did not change, whereas serum potassium decreased after irradiation. Sixty days following irradiation 95% of the high potassium and control diet rats had survived the 400 R. Only 55% of the low potassium diet rats survived. At the 1000 R dose level 64% of the high potassium group survived for 60 days while no rats survived in the other two diet groups. All data were tested by analysis of variance. (auth)

5344 RECOVERY OF FUNCTION AND CELL POPULATION IN THE INTESTINAL EPITHELIUM OF X-IRRADIATED MICE.

Tsubouchi, S.; Matsuzawa, T. (Aichi Cancer Center Research Inst., Nagoya, Japan). Radiat. Res.; 56: No. 2, 345-353(Nov 1973).

Injury and recovery of intestinal function following 1000 rads whole-body x-irradiation of female ICR/JCL mice was investigated by assaying activities of three enzymes (invertase, l-leucine aminopeptidase, alkaline phosphatase). By comparing changes in these enzyme activities with the epithelial cell kinetics of total DNA synthesizing cell number and total cell number, the causal relationships between functional changes in the small intestine and the epithelial cell kinetics involved in the recovery process were studied. After cell injury from irradiation, first the number of DNA synthesizing cells, second the number of total cells, and last the enzyme activities decreased to the minimum value. During recovery, the order was the same: first the DNA synthesizing cell number, then the total cell number, and finally the enzyme activities. This injury process was induced by epithelial cell death in the crypt, and the subsequent recovery was the result of epithelial cell proliferation and differentiation to functional cells of the villi. (auth)

5345 COURSE OF DEVELOPMENT OF LEISHMANIA ENRIETTII INFECTION IN IMMUNOSUPPRESSED GUINEA PIGS. Lemma, A.; Yau, P. (Stanford Research Inst., Menlo Park, CA). Amer. J. Trop. Med. Hyg.; 22: No. 4, 477-481(Jul 1973).

The course of development of L. enriettii infection in normal and immunosuppressed guinea pigs was studied. The leishmanial lesion in normal guinea pigs is confined and self-limiting, but in immunosuppressed animals it metastasizes and diffuses to various parts of the body, particularly the extremities. Successful immunosuppression for such studies can be achieved by administering antilymphocytic antiserum, cyclophosphamide, or whole-body irradiation. All such immunosuppressants must be continuously applied to lower the total white blood cell count to about 2,000/ml and maintain it at that level. (auth)

5346 RADIOSENSITIVE PERIOD OF PECKING RESPONSE DURING EMBRYOLOGICAL DEVELOPMENT OF DOMESTIC CHICKS. Strobel, M. G.; Freedman, S. L.; Kamra, O. P. (Dalhousie Univ., Halifax, Nova Scotia). J. Comp. Physiol. Psychol.; 84: No. 1, 82-87(Jul 1973).

Gamma irradiation of 174 chick embryos on days 2 to 12 of incubation in 2-day steps resulted in a fivefold increase in between-subjects variance and a threefold increase in within-subjects variance when tested with induced pecking responses, but only in groups treated on days 6 and 8. There was no difference in variances between groups treated on any other day nor in the controls. It was claimed that comparison of means was an inappropriate and misleading test for treatment effects. Results were discussed in terms of both raised thresholds and loss of negative feedback in the response system. (auth)

5347 BIOLOGICAL EFFECTS OF CORYNEBACTERIUM PARVUM. IV. Adjuvant and Inhibitory Activities on B Lymphocytes. Howard, J. G.; Christie, G. H.; Scott, M. T. (Wellcome Research Labs., Beckenham, Eng.). Cell. Immunol.; 7: 290-301(May 1973).

The PFC response to the thymus-independent antigen SIII (type 3 pneumococcal polysaccharide) was amplified in mice injected 4 days previously with killed Corynebacterium parvum. This adjuvant activity was demonstrable with high (2 to 50 μg) but not low (0.1 to 0.5 μg) doses of SIII. Induction of tolerance was unaffected. Depression of the response resulted from simultaneous injection of SIII with either C. parvum or Bordetella pertussis, while prior treatment with the latter was without effect. Responsiveness to SIII was transiently but potently suppressed in spleen cells transferred into lethally irradiated, C. parvum pretreated mice. Although C. parvum is an effective B cell adjuvant, other data imply that it acts indirectly on these lymphocytes. It is argued that both adjuvant and suppressive activities of C. parvum on the B cell response to SIII are most probably mediated by activated macrophages. (auth)

5348 PROTECTION AGAINST RADIATION LEUKEMOGENESIS BY REPEATED INJECTIONS OF IMMUNE AND NONIMMUNE FOREIGN SERA. Ferrer, J. F.; Lieberman, M.; Kaplan, H. S. (Stanford Univ., CA). Cancer Res.; 33: 1339-1343(Jun 1973).

Significant inhibition of lymphoid tumor development was observed in x-irradiated strain C57BL mice treated with multiple injections of rat antiserum prepared by immunization of Wistar-Furth or (Wistar-Furth · BN) F_1 rats with histocompatible lymphomas induced by the radiation leukemia virus (RadLV). However, there was also significant inhibition, relative to phosphate buffered saline controls in C57BL mice that received injections of normal rat serum. This prompted additional experiments in which fetal calf serum or Freund's complete adjuvant was injected as nonspecific immunostimulants. Strong protection was observed with fetal calf serum, and a slight inhibitory effect (not significant) was also seen with Freund's complete adjuvant. The results are discussed in terms of the following alternative interpretations, which are not mutually incompatible: (a) the inhibitory effect of the rat anti-RadLV serum, as well as that of normal serum, which may have contained natural antibody to RadLV, is due to passive immunization by specific antiviral antibody, thus further implicating RadLV in the etiology of radiogenic lymphomas; (b) the protective effect is due to hyperimmunization of the mice against foreign (rat and bovine) sera, leading to nonspecific stimulation of the immune surveillance mechanisms of the host animals; and/or (c) prevention by the foreign sera is due to the radiation leukemia protection factor described by Berenblum et al. (auth)

5349 INFLUENCE OF X IRRADIATION ON EXPERIMENTAL AUTOALLERGIC SIALADENITIS. White, S. C. Rochester, NY; Univ. of Rochester (1973). 224p. Microfilms Order No. 73-26,560. Thesis (Ph. D.).

The influence of localized irradiation (1000 R) on the time of development and intensity of an immunologically mediated inflammatory lesion was investigated. An experimental autoallergic sialadenitis (EAS) of the rat submandibular gland was developed to serve as the standard lesion. Consistently mild or severe lesions of EAS were induced in male Lewis rats when they were immunized with allogenic submandibular glands from sexually immature or mature female donors, respectively. Neck irradiation (1000 R) 7 to 56 days prior to sacrifice induced only occasional inflammatory lesions in the submandibular glands. The weights of both the thymus and submandibular glands were seen to decrease progressively while the body weights continued to rise. Neck irradiation (1000 R) 7 to 56 days prior to sacrifice of animals immunized 7 to 21 days prior to sacrifice to induce mild or severe EAS did not significantly accelerate development of the lesion nor was the intensity of inflammatory lesions significantly modified. In animals with mild or severe EAS which were neck-irradiated, the weights of both the submandibular glands and thymus were found to decrease while the body weight remained relatively unchanged. Administration of EACA (2 minutes before or 6 hours after irradiation) to animals that were neck-irradiated and/or immunized did not significantly modify the intensity of the inflammatory lesions of the submandibular gland, nor did it modify the weight changes seen in the submandibular or thymus gland or whole body. Thus, the influences of neck-irradiation (1000 R) (primarily a progressive submandibular and thymic weight decrease) neither significantly altered nor were altered by the development of the experimental autoallergic lesion of the submandibular gland. Rather, the consequences of the two procedures to these organs appeared to be additive and otherwise essentially independent of each other with respect to both submandibular and thymus glands. (Diss. Abstr. Int., B)

5350 HUMORAL CONTROL OF HEMOPOIESIS. Gordon, A. S.; Zanjani, E. D. (New York Univ., NY). Advan. Intern. Med.; 18: 39-58(1972).

In the normal animal, acute changes in the numbers of circulating blood cells caused by alterations in their production or destruction are followed by adjustments in the rates of these reactions, resulting eventually in the restoration of normal cellular levels. This series of events suggests a feedback control triggered by the requirements of the organism for new cells. Major mechanisms that most likely operate in this feedback regulation are either humoral in nature or involve direct cellular carriage of information. This review is confined to some aspects of the humoral control of hemopoiesis. Influences exerted on erythropoiesis, leukopoiesis, and thrombopoiesis are considered. (auth)

5351 POSSIBLE SYNERGISTIC EFFECTS OF RADIATION AND ESTROGEN IN THE PRODUCTION OF RENAL TUMORS IN THE MALE SYRIAN HAMSTER. Barber, L. R. Lafayette, IN; Purdue Univ. (1972). 127p. University Microfilms Order No. 73 28,035.

Thesis (Ph. D.).

Possible synergistic effects between radiation and estrogen in producing kidney tumors were investigated and the effects of the two agents on nucleic acid metabolism were studied. Male Golden Hamsters were divided into three experimental groups. In Group I the radiation was given 1 month before the estrogen was started, in Group II the radiation was given at the same time the estrogen was started, and in Group III the radiation was given 2 months after the estrogen was started. The animals were then serially sacrificed at four different time periods after the estrogen was started. In addition, there existed three control groups, one group that received no treatment, one group

that received radiation to the left kidney only and one group that received estrogen only. The radiation consisted of 800 rads of energetic β-particles localized to the left kidney only, using a ^{90}Sr eye-applicator source. The estrogen was administered in the form of 30 mg implants of 17β-estradiol repeated every 5 weeks. In general, no significant differences were seen in the incidence of tumors in kidneys that had received both radiation and estrogen and in kidneys that had received estrogen only. No tumors were seen in kidneys receiving radiation only or ones that received no treatment. The ratio of the specific activity of the irradiated kidney to the specific activity of the unirradiated kidney was calculated for both the RNA and DNA for each time period. Only in Group I was there observed a significant change in the ratio over the four exposure periods. In this group the ratio was quite low (0.6 to 0.7) in the beginning and increased progressively until at the 4th period it was approximately one or slightly above one. In Groups II and III, no significant change was seen over the four exposure periods. All of the values were, however, greater than one and were near the value of the control group that received estrogen only (the ratio of this group was the left kidney to the right kidney). The control group receiving no treatment had a ratio approximately one and the control group receiving radiation to one kidney only had a ratio slightly less than one. Although the ratios over the four periods changed only in Group I, the average specific activity was found to change greatly in all three groups for both the RNA and the DNA. The average specific activity decreased progressively from the first exposure period to the 4th by almost a factor of 10 in Group I and Group II. In Group III, the change was not as great. The total RNA and total DNA was determined in Group II to see if any change was occurring over the treatment periods. Both the total RNA and DNA (in mg/gm wet tissue) of the 4th period were significantly less than one of the other time periods, indicating perhaps, a decreasing trend with treatment. (Diss. Abstr. Int., B)

5352 INFLUENCE OF GENOTYPE AND NEONATAL IRRADIATION UPON OPEN-FIELD LOCOMOTION AND ELIMINATION IN MICE. Nash, D. J. (Colorado State Univ., Fort Collins). J. Comp. Physiol. Psychol.; 83: No. 3, 458-464(Jun 1973).

A diallel genetic analysis was used in a study of postnatal behavior of mice that were exposed to neonatal irradiation. Five levels of exposure were used: 0, 50, 100, 200, or 300 roentgens. Locomotion and elimination in the open field were tested at 49 days of age. Decreases in body weight and locomotion were observed. Heterosis was evident in locomotion and elimination, hybrids being more active (18%) and eliminating more (39%) than inbreds. Other genetic influences on behavior were noted in the significant differences among inbreds, in general, combining ability and maternal effects. Results demonstrate that the genetic mechanisms underlying control of locomotion and elimination in the open field are complex and that specific interactions may exist among the sexes and genotypes in nonirradiated, as well as irradiated, animals. (auth)

5353 IN VIVO STUDY OF THE EFFECTS OF X RADIATION ON THE CHROMOSOMES OF CHICK ALLANTOIC MEMBRANES. Cormier, J. M.; Bloom, S. E. (Cornell Univ., Ithaca, NY). Mutat. Res.; 20: No. 1, 77-85(Oct 1973).

The allantoic sacs of chick embryos, x-irradiated in ovo early on the fifth day of incubation, were examined for the presence of induced chromosomal abnormalities. Detection of breaks and gaps was possible for chromosome pairs 1 to 5 representing about 50% of the nuclear DNA per cell. Four of the many factors known or suspected of influencing the occurrence or detection of such cytogenetic changes were considered. They included the total radiation exposure, the length of post-irradiation incubation, the method of tissue fixation, and the staining procedure. The yield of aberrations was found to be dependent in part on radiation exposure and time. With an increase in total exposure, a proportional increase in the frequency of one-hit aberrations (gaps and breaks) was observed. The total exposure has little effect on the type of aberration produced, with similar proportions of gaps and breaks recorded at each level. Abnormalities occurred at random along the length of the chromosome in frequencies proportional to the size of the chromosome being considered. The Z chromosome was affected less often than was dictated by its size, and provided the exception to this general result. The relatively high incidence of chromosomal abnormalities present 1 h after x-ray exposure decayed with time, and nearly vanished after 8 h of post-irradiation incubation. The two fixatives tested (1 : 1 ethanol–acetic acid and 3 : 1 ethanol–acetic acid) seemed to be of equal value in their selective preservation of the chromosomes. Neither demonstrated any particular advantage for the detection of chromosome aberrations in spite of the enhanced despiralization produced with the 1 : 1 fixative. The Giemsa and crystal violet dyes were observed to stain C-metaphase chromosomes equally well. However, the crystal violet method was simpler, faster, less sensitive to pH, and more reliable than was the Giemsa procedure. Although the stained slides offered the advantages of permanent preparations, the metaphase plates were sometimes distorted by certain artifacts resulting from freezing and air-drying. The unstained squash preparations showed relatively few artifacts and thus provided a valuable means for the observation of chromosome abnormalities. (auth)

5354 RADIOSENSITIZATION OF EL4 LYMPHOMA CELLS BY A COMMONLY USED FOOD ADDITIVE-BUTYLATED HYDROXYTOLUENE. Kamra, O. P.; Ghose, T.; Mammen, M. (Dalhousie Univ., Halifax, Nova Scotia). Mutat. Res.; 21: No. 5, 293-295(Oct 1973).

The potential radiosensitizing ability of the food additive butylated hydroxytoluene (BHT) on mouse EL4 lymphoma cells was investigated. The results indicate that BHT is a very potent radiosensitizer for the EL4 lymphoma cells. (ERB)

5355 FATTY AND PHOSPHOLIPID ACIDS IN THE RENEWED TISSUE OF A BONE FRACTURE GIVEN TO IRRADIATED MICE. Effect of Cysteamine. Drouet, J.; Dupont, J.; Nguyen, T. L.; Fournie, J.; Goyffon, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). Compt. Rend. Soc. Biol.; 166: No. 12, 1585-1591(1972). (In French).

The fatty acid and phospholipid compositions of the bone callus of mice subjected to conjugate polyfracture and whole-body irradiation were studied both with and without classical radioprotective substances (cysteamine). An increase in the total amount of phospholipid was observed in the bone callus, the distribution of the phospholipid fractions remaining unchanged. When a cysteamine injection is given prior to the irradiation, an accumulation of stearic acid does not occur. (FR)

Invertebrates

5356 (COO-3093-4) INVESTIGATION ON THE STERILIZATION WITH RADIATIONS FOR THE CONTROL OF THE SOUTH AMERICAN FRUIT FLY ANASTREPHA FRATERCULUS (Wied.). Progress Report, October 1970–December 1971. Gonzalez Bachini, J. E.; Pantigoso, B. J. (Estacion Experimental Agricola de la Molina, Lima (Peru)). May 1973. Contract AT(11-1)-3093. 31p. Dep. NTIS $3.75.

Preliminary results are reported from studies on the effectiveness of the release of adult South American fruit flies (Anastrepha fracterculus) exposed to 6 kr γ radiation while pupae for the control of insect populations. Dispersion studies were carried out using adults marked with colored fluorescent powders. The number of adults captured 7 and 14 days following release in a citrus plantation or peach orchard was determined as a factor of distance from the point of release. (CH)

5357 (PRNC-161) INSECT STERILITY PROGRAM. Technical Report No. 7, February 1972 to April 1973. Walker, D. W. (Puerto Rico Nuclear Center, Mayaguez). Apr 1973. Contract AT(40-1)-1833. 41p. Dep. NTIS $4.25.

The Inherited Partial Sterility program for the control of lepidopteran pests by means of radioinduced mutations is discussed. Experimental designs are presented for the cage phase and the colony phase of the sterility tests. Results are presented of the analysis of laboratory data in relation to sex ratios, dose effect, and generation effect. The hemipterans, Nezara viridula and Diatraea saccharalis, were exposed to various doses of radiation and data are presented on survival and chromosomal aberrations. Effects of single and fractionated radiation doses on survival and reproduction of the wax moth, Galleria mellonella, were studied. Studies on host plant resistance to diseases and insect attack were conducted using beans and cowpeas. (HLW)

5358 PROBLEMS OF MUTATION DETECTION IN INDEPENDENTLY EVOLVING LABORATORY STRAINS. Roberts, P. A.; Vogel, E. (Univ., Leiden). Mutat. Res.; 21: No. 5, 297-299(Oct 1973).

The origin of strains of Drosophila and mice susceptible to x-ray and chemical mutagenesis is discussed. The probable causes of the genetic differences are briefly reviewed and a possible solution to the problem is suggested. (ERB)

5359 LACK OF MUTAGENICITY OF HYCANTHONE IN HABROBRACON SERINOPAE FEMALES. Smith, R. H. (Oak Ridge National Lab., TN). Mutat. Res.; 21: No. 5, 279-281(Oct 1973).

The pattern of egg production by females fed the hycanthone indicates that there was no detrimental effect on the ability of these females to produce eggs. This indicates that no change was induced in the general physiology of this insect. The absence of the typical depression in the egg production curve, like that seen

after x irradiation of virgin females, and the high hatchability of haploid eggs show that the feeding of hycanthone does not induce dominant or recessive lethal mutations in meiotically or mitotically active cells. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 5387.

5360 (INIS-mf-580) PROTECTION OF MAN AND HIS ENVIRONMENT AGAINST THE RISKS RESULTING FROM THE DEVELOPMENT OF THE NUCLEAR ENERGY: PRESENT STATUS, PROSPECTIVES. Lacourly, G. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 22p. (In French). INIS.

The anticipated development of the use of nuclear energy in the course of the next thirty years is considered in relation to the possible consequences of the release of radioactive waste on man and his environment in the year 2000. Although radiation has an influence on flora and fauna, experience proves that this problem can be neglected if the level of radiation protection laid down for human beings is complied with. The basic standards are established very carefully, so that the exposure of the populations remains well beneath the maximum radiation dose limits. When estimating the levels of balance reached in the biosphere, doses of radiation that arise from nuclear power plants can be compared to the limit doses in order to assess the risk for the population. (INIS)

5361 DOSE DISTRIBUTION IN HEALTHY LYMPH NODES AND IN LYMPH NODES AFFECTED BY METASTASES AFTER ENDOLYMPHATIC THERAPY WITH RADIONUCLIDES. I. Model Studies. Magnus, L. (Bochum Univ., Essen). Strahlentherapie; 145: No. 5, 571-581(1973). (In German).

The radiation dose in a metastasis, depending on its size, is ascertained on the phantom by the curves of film dosimetry. These investigations refer to the beta emitters ^{131}I and ^{32}P as well as to the gamma emitter ^{125}I. It was found that a metastasis of 3.5 mm in diameter in the ^{32}P-milieu in its center gets 50% of the ambient dose. In an ^{125}I-milieu a metastasis with a diameter of even 17 mm receives the same irradiation. This means a significant superiority of the gamma emitters in comparison to the beta emitters. Similar investigations were performed with regard to the ambient dose of a radioactive lymph node. Depending on the activity investigated, on the margin of the lymph nodes no more than 55 to 70% of the central dose is measured. With beta emitters, at a distance of 1 to 2 mm from the margin of the lymph node, with gamma emitters at 10 mm, less than 10% of the central dose is measured. Therefore, even with endolymphatic therapy with gamma emitters, a marked radiation exposure of the healthy environment is not to be expected. ^{99m}Tc and ^{85}Sr were included in these investigations. (GE)

Nuclide Kinetics and Toxicology

Refer also to abstract 7400.

Man

Refer also to abstract 6756.

5362 URANIUM. Suzuki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Shin Kinzoku; 18: No. 5, 118-123(May 1973). (In Japanese).

Uranium poisoning was examined histologically including reports on poisoning in the Manhattan Project in U. S. A. In human and animal experiments, the essential poisoning of uranium has been demonstrated to be chemical poisoning and to cause nephritis with uranium and other diseases related to it. If fuels containing thorium-uranium-233 series are used in the future, radiation injury will appear in the following occasions: 1) when uranium is accumulated in the organs of humans, especially in the lungs: 2) when the human body gets near the place where a great amount of uranium with daughter radionuclides in a great quantity is present. There are differences in the level of poisoning between uranium with valences of 4 and 6; Above all, uranium with valence of 6 in aqueous solutions has the ability to produce anionic complex. The amount of uranium in each tissue of mouse was examined in order to study the kinetics of uranium compounds in the body. The effect of uranium poisoning on nephrons of the kidney during its metabolism is caused by combination of uranium ions with CO^- of proteins in the cells, which denatures the proteins and destroys the epithelial cells to necrosis. (JA)

5363 CESIUM-137 TURNOVER RATES IN HUMAN SUBJECTS OF DIFFERENT AGES. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Beckner, W. M. Health Phys.; 25: No. 6, 603-605(Dec 1973).

The whole-body counting and urinalysis methods were employed to determime the ^{137}Cs biological turnover rates in contaminated human subjects of different ages. These two methods show agreeable results of 83 to 85 days for 40-yr old male, 60 to 66 days for 39-yr old female, 52 to 55 days for 12-yr old male, 37 to 43 days for 10-yr old male, and 29 to 38 days for 6-yr old male. (UK)

5364 CESIUM-137 HALF-TIMES IN HUMANS. Lloyd, R. D. (Univ. of Utah, Salt Lake City). Health Phys.; 25: No. 6, 605-610(Dec 1973).

A detailed analysis is made of the results given in a large number of reports already published of the parameters that affect the human biological half-time for ^{137}Cs. It was concluded that this can be considered as a function of age for juveniles and sex for adults but is not determined by body mass, although both body mass and equivalent biological half-time are, undoubtedly, dependent on some other common factor or factors. It has been suggested that the rate of cesium turnover may be under hormonal influence or control or may reflect the general metabolic rate. Experiments in animals appear to confirm the earlier but inconclusive results in humans that indicated that ^{137}Cs half-times were dependent upon thyroid function. Some other types of hormones that were studied (ACTH, adrenal hormones, sex hormones, and growth hormone) show less clearcut effects on the metabolism of alkali metal elements. Aldosterone, however, seems to be uniformly linked to changes in excretion and retention. It is suggested that knowledge of the response of ^{137}Cs excretion rates in humans to the administration of, for example, thyroid hormones, aldosterone, sex hormones, or chorionic gonadotropin under controlled conditions would be of great value in defining the parameters that control cesium metabolism in man. (UK)

5365 DISTRIBUTION OF PLUTONIUM AND AMERICIUM IN OCCUPATIONALLY EXPOSED HUMANS AS FOUND FROM AUTOPSY SAMPLES. Lagerquist, C. R.; Hammond, S. E.; Bokowski, D. L.; Hylton, D. B. (Dow Chemical Co., Golden, CO). Health Phys.; 25: No. 6, 581-584(Dec 1973).

Nineteen cases are discussed where tissues were obtained from autopsy and analyzed radiochemically for plutonium and americium. Distribution patterns varied greatly from case to case, depending on: the mode of entry, the chemical form, the length of time since exposure, and perhaps many other parameters as well. A typical distribution was not found, but on the average the lung and tracheal-bronchial lymph nodes had the highest concentration of material followed by the liver, the bones, and finally the other tissues. (auth)

5366 INTAKE AND EXCRETION PATTERNS OF NATURALLY OCCURRING RADIUM-226 IN HUMANS. Spencer, H.; Kramer, L.; Samachson, J. (Veterans Administration Hospital, Hines, IL). Radiat. Res.; 56: No. 2, 354-369(Nov 1973).

The dietary intake and the urinary and fecal excretion of naturally occurring ^{226}Ra and ^{228}Ra balances were determined in man under strictly controlled dietary conditions. These provided the basis for calculating the ^{226}Ra balances. These balance studies were carried out during a low calcium intake, during the addition of different amounts of calcium given as calcium gluconate, and during the intake of milk. ^{226}Ra balances were also determined during conditions that affect the metabolism of calcium: during intravenous infusions of stable strontium, during infusions of ACTH, and during total calorie starvation. During a low calcium intake of an average of 243 mg/day, the urinary ^{226}Ra excretion averaged 0.016 pCi/day, during a calcium intake of 1300 mg or 2600 mg/day, given as calcium gluconate, the urinary ^{226}Ra excretion did not increase, while during supplementation of the diet with milk the urinary ^{226}Ra excretion increased. On all calcium intakes the urinary ^{226}Ra excretion averaged 3% of the total excretion except that it was 12% on milk intake. The major pathway of ^{226}Ra excretion was via the intestine and the ^{226}Ra balances were in equilibrium under all study conditions. There was no correlation between the urinary ^{228}Ra and the urinary calcium excretion. (auth)

5367 DEVELOPMENT OF A CONSISTENT ANALYTICAL MODEL FOR DETERMINING DOSE FROM PuO_2 INHALATION. Woodsum, H. C. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 538-539(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Animals

5368 (BMVg-FBWM-71-1) INVESTIGATIONS ON INCORPORATION AND ENHANCEMENT OF EXCRETION OF RADIOISOTOPES AND INTERNAL DOSIMETRY. Steinbach, K. H. (comp.). (Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Dokumentationszentrum der Bundeswehr). 1971. 88p. (In German). INIS.

The influence of duration of incorporation, age, and sex on the Y/Sr-activity relation in the femur of rats was investigated after i.v. injection of ^{90}Sr and ^{90}Y (10 μCi $^{90}Sr-^{90}Y$) into rats. After an incorporation of 1 to 156 d the animals were sacrificed and the femur removed. After puncturing the distal femur, LiF-thermoluminescent dosemeters were introduced and exposed up to 6 d. After the removal of the detectors the femur was prepared for determination of the ^{90}Sr concentration. The energy dose rate was determined in rads/d by means of dosemeters, with the calibration being done in a ^{90}Sr-solution of known activity concentration. A ^{90}Sr source with which the dosemeters were irradiated under constant geometry was calibrated according to the defined relation between energy dose and the record of the measuring device. The energy dose rate decreased with increasing incorporation time. The influence of sex was indicated by the 20% lower energy dose rate of males. This difference decreased up to the 32nd dose day. (INIS)

5369 (BNWL-SA-4682) EFFECT OF VENTILATION VARIABLES ON BREATH THORON OUTPUT. Ballou, J. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 17p. (CONF-730915-9; UR-3490-298). Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

The radioactive noble gas thoron (^{220}Rn) was measured in the breath of dogs following intramuscular injection or inhalation of ^{228}Th-enriched ThO_2. With increased ventilation the amount of exhaled thoron increased both in the injected dogs and in artificially ventilated lungs from dogs that had inhaled ThO_2. In general thoron was washed from the lung more efficiently by the normal breathing maneuvers of the intact dogs than by artificial ventilation of their excised lungs. It was possible, however, to obtain marked variations in the thoron output by imposing rather bizarre ventilation patterns on the artificially ventilated lungs. (auth)

5370 KINETICS OF STRONTIUM-85 ABSORPTION BY BONE TISSUES OF RATS IN VIVO AND IN VITRO. Golutvina, M. M.; Kononykina, N. N.; Borisov, N. E. (Inst. of Biophysics, Moscow). Biol. Nauki; No. 10, 49-52(Oct 1972). (In Russian).

The kinetics of the absorption of ^{85}Sr by bone tissue in the first minutes and hours after a single intravenous injection of the isotope were studied. It was shown that the isotopic content in the skeletal tissue of the rat rapidly increased, and by 6 hrs after the injection 74% of the injected quantity is accumulated; of this 7.2% is located in the organic matrix of the bone and 92.8% in the bone mineral. The kinetic parameters of the fast and capacious stages of the isotope absorption process in the living organism are close to the parameters obtained earlier in the in vitro tests. The process of rapid ^{85}Sr absorption in living bone tissue apparently represents the kinetic exchange of ions on the surface of the hydroxylapatite crystal. (tr-auth)

5371 EVALUATION OF RADIOMETRIC MEASURES OF THE BODY SURFACE OF ANIMALS TO DETERMINE THE RATE OF RADIOACTIVE CONTAMINATION OF MUSCLES AND INTERNAL ORGANS WITH ^{134}Cs. Jaworek, D.; Szulc, M. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw). Med. Wet. (Poland); 28: 557-559(1972). (In Polish).

The possibility of discovery and determination of internal contamination with radioactive substances by means of supravital radiometric measures of body surface was studied. The experiments were carried out on rabbits that were given ^{134}Cs intragastrically. The animals were examined every day. Simultaneously the rabbits were killed after 2, 4, 7, 10, 17, 24, and 31 days following the experimental contamination. Internal organs and samples of muscles were taken to determine the content of ^{134}Cs. It was found that there was a distinct correlation between the supravital findings and the activity of ^{134}Cs in muscles, especially between 10 to 24 days following the radioactive contamination. It seems that in case of large animals the results should be even more reliable as the probe applied to thicker layers of muscles would not measure the radioactivity coming from internal organs, in which the content of Cs in the first days after radioactive contamination is relatively high. (auth)

5372 AUTORADIOGRAPHIC STUDIES OF DISTRIBUTION IN THE LIVER OF ^{198}Au AND ^{99m}Tc-SULFUR COLLOIDS. Chaudhuri, T. K.; Evans, T. C.; Chadudhuri, T. K. (Univ. of Iowa, Iowa City). Radiology; 109: No. 3, 633-637(Dec 1973)

There are observable differences in the way in which the liver handles ^{198}Au and ^{99m}Tc-sulfur colloids. Studies were made with serial autoradiography following intravenous injection of these two colloids into mice. ^{198}Au colloid passes through three distinct stages of phagocytosis by Kupffer's cells. In sharp contrast, ^{99m}Tc-sulfur colloid does not. (auth)

5373 FETAL UPTAKE OF CERIUM-144-PRASEODYMIUM-144 AFTER INJECTION OF ITS CHELATES TO PREGNANT RAT. Beno, M. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). Health Phys.; 25: No. 6, 575-580(Dec 1973).

On the 17th day of pregnancy, albino rats were injected intravenously with $^{144}Ce-^{144}Pr$ (designated hereinafter as ^{144}Ce with the ^{144}Pr daughter assumed to be in equilibrium) chloride, citrate, nitrilotriacetate (NTA), or ethylenediaminetetraacetate (EDTA) and sacrificed at intervals up to 4 days later. The radioactivity of fetuses, placentae, amniotic fluid, maternal blood and maternal femora was measured. Deposition of the four ^{144}Ce compounds in the fetuses was small: the greatest deposition, 0.013% of the injected dose deposited in one fetus, was observed 4 days after injection of $^{144}CeEDTA$. The radioactivity of the fetuses generally increased with time after injection of $^{144}CeCl_3$ or $^{144}CeEDTA$. Deposition of ^{144}Ce in the fetuses was greatest after injection of $^{144}CeEDTA$ or ^{144}Ce-citrate and least after injection of $^{144}CeCl_3$ or $^{144}CeNTA$, but the differences were not always significant. Deposition of ^{144}Ce in the placenta was greatest after injection of $^{144}CeEDTA$. Deposition of ^{144}Ce in maternal bone was significantly greater after injection of ^{144}Ce chelates than after injection of $^{144}CeCl_3$. (auth)

5374 METABOLISM AND ANTICONVULSANT ACTIVITY OF DEUTERATED N-DEMETHYLDIAZEPAM. Marcucci, F.; Mussini, E.; Martelli, P.; Guaitani, A.; Garattini, S. J. Pharm. Sci.; 62: No. 11, 1900-1902(Nov 1973).

The substitution of the hydrogen at the C_3-position of N-demethyldiazepam with deuterium shortens the anticonvulsant activity in mice from 20 to 5 hr. This pharmacological effect may be partly explained by a decrease in the ability of deuterated N-demethyldiazepam to protect mice from pentylenetetrazol-induced convulsions in contrast to the effect exerted by the C_3-unlabeled analog. Furthermore, the weaker pharmacological action of deuterated N-demethyldiazepam may in part be due to the lesser accumulation of the hydroxylated metabolite, oxazepam, in the brain of mice treated with deuterated N-demethyldiazepam than with the unlabeled analog. The lesser accumulation of oxazepam from deuterated N-demethyldiazepam than from the unlabeled analog is due to a reduced C_3-hydroxylation of this compound by liver microsomal enzymes, as shown by experiments in vitro. (auth)

5375 BINDING OF POLONIUM-210 TO RAT TISSUES. Lanzola, E. E.; Allegrini, M. E.; Taylor, D. M. (Univ., Pavia, Italy). Radiat. Res.; 56: No. 2, 370-384(Nov 1973).

The subcellular distribution of ^{210}Po was studied over periods of up to 47 days after intravenous, oral, or intramuscular injection of the nuclide as citrate or in colloidal form. The majority, 50 to 80%, of the total tissue ^{210}Po was found in the cytosol of liver, kidney, and testis irrespective of the time after injection, the route or form in which the nuclide was administered. Fractionation of the cytosol on Sephadex G.200 suggested that the ^{210}Po was bound nonspecifically to protein. Studies of the distribution of ^{210}Po in digests of freeze-dried liver from animals injected with ^{210}Po and in synthetic mixtures of amino acids after separation on Sephadex G.15 suggest that the sulphydryl group of cysteine may be an important binding site for ^{210}Po in proteins. Slight changes in the ^{210}Po distribution profile were seen when lipid was extracted from the freeze-dried liver powder before digestion suggesting that lipids may be involved in the ^{210}Po complex in vivo, but no direct evidence for polonium-lipid complexes was found. (auth)

5376 ISOLATION AND PARTIAL CHARACTERIZATION OF A ^{51}Cr COMPLEX FROM BREWERS' YEAST. Votava, H. J.; Hahn, C. J.; Evans, G. W. (Dept. of Agriculture, Grand Forks, ND). Biochem. Biophys. Res. Commun.; 55: No. 2, 312-319 (16 Nov 1973).

A butanol : H_2O extract of Brewers' yeast grown in a medium which contained ^{51}Cr was analyzed by gel-filtration chromatography. A single radioactive peak was eluted at an elution volume that suggested a molecular weight of approximately 400 to 600 daltons. Subsequent examination of pooled radioactive fractions obtained from gel-filtration chromatography demonstrated that the ^{51}Cr complex was eluted in a single peak from both cation- and anion-exchange resins. The elution characteristics of the ^{51}Cr complex indicated that the compound is a single anionic species. The ^{51}Cr complex was purified by a combination of

gel-filtration chromatography and ion-exchange chromatography and subsequently analyzed by thin-layer chromatography. The results indicated that the ^{51}Cr complex from Brewers' yeast is a peptide that contains at least six amino acids. When a partially purified preparation of the ^{51}Cr complex from yeast was administered orally to rats, the absorption and retention of ^{51}Cr was significantly greater than that in rats given ^{51}Cr in the form of $CrCl_3 \cdot 6H_2O$. These experiments demonstrate that chromium is associated with a single metal-binding peptide in Brewers' yeast and indicate that the chromium in this complex is absorbed and retained more efficiently than chromium salts. (auth)

5377 TRACER STUDY OF THE DISTRIBUTION OF METHYL MERCURY IN PREGNANT RATS. Robkin, M. A.; King, R. B. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 17: 95-96(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

New Tracer Techniques

Refer also to abstracts 4940, 5181, 5185, and 5320.

5378 (BNL-18094) THALLIUM-201 FOR MEDICAL USE. Lebowitz, E.; Greene, M. W.; Bradley-Moore, P.; Atkins, H.; Ansari, A.; Richards, P.; Belgrave, E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 16p. (CONF-730662-1). Dep. NTIS $3.00.

From 20th annual meeting of the Society of Nuclear Medicine; Miami Beach, Florida, USA (12 Jun 1973).

The advantages of using ^{201}Tl as an analog for K in diagnostic tracer studies are discussed. It is pointed out that the photons of ^{201}Tl are detected with high efficiency and resolution in a low-energy collimator γ camera system. Tissue distribution studies in goats show that ^{201}Tl concentrates in the renal medulla and would be of value in kidney function studies, has a differential uptake in melanomas, and concentrates in the myocardium, making it advantageous for myocardial visualization and function studies. (CH)

5379 (BNL-18198) MEASUREMENT OF "CLOSING VOLUME" AS AFFECTED BY LUNG VOLUME AT TRACER BOLUS INSPIRATION, BREATH HOLDING, AND EXPIRATORY FLOW RATE. Susskind, H.; Richards, P.; Atkins, H. L. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 13p. (CONF-730950-1). Dep. NTIS $3.00.

From international symposium on regional lung function and closing volumes; Malmo, Sweden (14 Sep 1973).

The measurement of closing volume is of great interest in the early detection of diseases of the small airways, especially if this technique can be used for mass screening with mobile equipment. The basis underlying the closing volume measurement involves either the inspiration of a tracer gas bolus, such as radioactive ^{133}Xe or ^{13}N or stable argon or helium, followed by measurement of the tracer concentration in the expirate, or analysis of the expirate for nitrogen, following a vital capacity (VC) inspiration of pure oxygen. The point (expired volume) at which the alveolar gas concentration changes discretely from the alveolar plateau, Phase III, to Phase IV is denoted as the closing volume, and is believed to represent the onset of closure of the dependent airways. The mechanisms involved were studied in four healthy young human volunteers following the inhalation of a 1-ml bolus of helium. (CH)

5380 (BNL-18304) CORRELATION OF RADIAL BONE MINERAL CONTENT WITH TOTAL-BODY CALCIUM IN VARIOUS METABOLIC DISORDERS. Cohn, S. H.; Ellis, K. J.; Zanzi, I.; Letteri, J. M.; Aloia, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1973. 18p. (CONF-731036-1). Dep. NTIS $3.00.

From international conference on bone mineral measurement; Chicago, Illinois, USA (12 Oct 1973).

Loss of bone mineral content of the skeleton in osteoporosis and in other metabolic disorders can be measured directly by total-body neutron activation analysis (TBNAA). The densitometric technique (using monochromatic photons from ^{125}I) applied to the appendicular skeleton (radius) also reflects the loss of bone mineral in osteoporosis. In the present study the results of these two techniques are compared in 80 patients with various metabolic disorders and in 9 normal contrast subjects. It is apparent that there is good correlation between total body calcium (TBCa) and bone mineral content (BMC) in all groups studied. The correlation was highest in the normal contrast group (0.97) and alcoholics(0.98) and lowest in osteoporotic patients (0.83) and in renal patients on dialysis (0.84). In order to measure the relative deficit in TBCa in individual patients from the absolute calcium measurement, it is necessary to normalize the data for sex, age, and skeletal size. For this purpose an algorithm was used to predict the normal skeletal Ca in each subject based on weight, height, sex and age. In similar manner, BMC data were normalized using the same algorithm. These normalization procedures allow both the TBCa and BMC measurement of the radius to be used to compare the Ca deficit in individuals with different metabolic disorders. (auth)

5381 (CONF-730302-17) NUCLEAR CONSTANTS IN THE PHARMACOPOEIAS: THEIR USE FOR THE NORMALIZATION OF RADIOPHARMACEUTICAL SUBSTANCES. Cohen, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur Yvette (France). Dept. des Radioelements). 1973. 6p. (In French). (SM-170/70). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973.

Variations in nuclear constants of radionuclides used frequently in medical diagnosis and therapy published in the literature on radiopharmaceuticals and nuclear data of various countries are pointed out. Difficulties encountered in determining the physiochemical properties of radiopharmaceuticals and in estimating the radiation dose to tissues following radionuclide administration are discussed. Comparative data from various sources on the half-life and energy of the characteristic γ photon are presented for ^{51}Cr, ^{57}Co, ^{58}Co, ^{59}Fe, ^{125}I, ^{131}I, ^{32}P, and on the mode of decay and abundance of internal conversion electrons for ^{197}Hg and ^{75}Se. Data are also included on the radioactivity in a number of radiopharmaceuticals produced in several countries. (CH)

5382 (INIS-mf-420) PREPARATION OF LABELED PARTICLES FOR PERFUSION STUDIES. Alvarez, J. (Comision Nacional de Energia Nuclear, Mexico City). 1972. 9p. (In Spanish). INIS.

A comparative study was made of the techniques for the preparation of the various labelled particles used in nuclear medicine for perfusion studies. The macroaggregates of albumin labeled with ^{131}I, ^{113m}In, or ^{99m}Tc, particles of sulfur and albumin, and inorganic particles (tin hydroxide, ferric hydroxide, or aluminum hydroxide) labelled with ^{99m}Tc and other radionuclides are cited. Other particles such as dextran, gammaglobulin, agar-agar, thioneine, carbonates of calcium or strontium, calcium phosphate, and macroaggregates of tin albumin are also discussed. A comparison was made between the albumin macroaggregates and macrospheres considering various factors such as the method of preparation of the particles, uniformity of size, ease of labelling with a great number of radionuclides, fragility, sterilization, harmlessness, biological life, and quality control. (tr-INIS)

5383 (INIS-mf-421) RADIOPHARMACEUTICALS: THEIR PREPARATION, CONTROL, AND BIOLOGICAL PROPERTIES. Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Investigaciones). 1972. 10p. (In Spanish). INIS.

A general discussion is presented of the nature of radiopharmaceuticals and their use in nuclear medicine. The introduction of isotope generators and their basic principles are discussed briefly. A description is given of the most used type of generator. Alternative methods for the separation of isotopes of medium short life, such as solvent extraction and sublimation, are cited. These isotopes permit the radiopharmacist to prepare various compounds which can be used widely in medical applications. The existence of kits makes their preparation much more simple. The necessity of controlling adequately these molecules is recalled. The radionuclide, radiochemical, and chemical purity must be determined. The activity concentration, specific activity, sterility, isotonicity, and pH must also be determined. The fractionation, dilution, elution, control of the radionuclide reserves, and the preparation of personnel techniques, are tasks which require much vigilance by radiochemists and radiopharmacists working in close contact with physicists and doctors. In recent years the field of nuclear medicine has changed rapidly with the use of isotopes of very short life and the introduction of new drugs which reduce the dose to the operator and to the patient and improve diagnostic techniques. At the present use is being made of isotopes called icons which can be detected by means of nuclear magnetic resonance. (tr-INIS)

5384 (LBL-2157) RUBIDIUM-81 USED AS A MYOCARDIUM IMAGING AGENT. Budinger, T. F.; Yano, Y.; McRae, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 9p. (CONF-730944-2) Dep NTIS $3.00.

From 11th international annual meeting of the German Society of Nuclear Medicine; Athens, Greece (24 Sep 1973).

Rubidium-81 is a new myocardial imaging agent with an ideal $T_{\frac{1}{2}}$ of 4.6 hr and energies acceptable for gamma-camera viewing. The target-to-nontarget ratio for heart image to background in the

projection images is usually less than 2 : 1, thus good statistics are necessary to delineate lesions. The low radiation dose and availability of this isotope allow one to obtain 6 to 10 times the data, and ^{81}Rb is probably superior to ^{129}Cs and ^{43}K for myocardial imaging if adequate collimation is present. (auth)

5385 (LBL-2161) QUANTITATIVE SEQUENTIAL IMAGING OF RADIONUCLIDE DISTRIBUTION USING THE WHOLE-BODY SCANNER AND THE GAMMA CAMERA: ABSOLUTE ACCURACY AND ASPECTS OF THREE-DIMENSIONAL RECONSTRUCTION. Budinger, T. F.; Gullberg, G. T.; Nohr, M. L.; McRae, J.; Anger, H. O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 20p. (CONF-730944-3). Dep. NTIS $3.00.

From eleventh international annual meeting of the German Society of Nuclear Medicine; Athens, Greece (24 Sep 1973).

Progress in quantitating the distribution of isotope within organs on sequential images of the whole body using the whole-body scanner, and on techniques of reconstructing the three-dimensional distribution from multiple gamma-camera views using a variety of different algorithms is reported. The following variables are involved in the precise quantitation of the amount of radiopharmaceuticals in regions of the body: geometry effect, patient thickness, thickness and homogeneity of isotope distribution, source position, one photon attenuation coefficient. The whole-body scanner used consists of 64 detectors distributed as four rows of 16 detectors with a diagonal offset to give good resolution and adequate collimation between the single 3.2-cm diameter by 3.8-cm thick sodium iodide (Tl) crystals. The patient is positioned on a bed that is moved over the detector array and pulse-height selection is used to separate pulses between different isotopes. The scan durations can vary from 0.75 minute to hours. (auth)

5386 RADIOISOTOPE EXPERIMENTS IN PHYSICS, CHEMISTRY, AND BIOLOGY. Second Revised Edition. Dance, J. B. London; Hutchinson Educational (1973). 239p.

It is stated that the main object of the book is to show that a large number of experiments in chemistry, physics and biology can be safely carried out with a minimal amount of equipment. No sophisticated counting equipment is required, in most cases simple geiger counters or photographic emulsions are used, but a few experiments are included for use with other forms of detectors, such as pulse electroscopes, which are often found in schools. Using naturally occurring compounds, sealed sources and some unsealed sources of low specific activity, experiments are given of typical applications in statistics, electronics, photography, health physics, botany and so on. The necessary theoretical background is presented in the introductory chapters and typical problems are given at the end of the book. The book is intended for GCE and Advanced level students. (UK)

5387 RADIOIMMUNOASSAY FOR LYSERGIDE (LSD) IN ILLICIT DRUGS AND BIOLOGICAL FLUIDS. Loeffler, L. J.; Pierce, J. V. J. Pharm. Sci.; 62: No. 11, 1817-1820(Nov 1973).

A simple and convenient radioimmunoassay system is described for the qualitative detection and quantitative determination of lysergide (LSD) in illicit drugs, human plasma, serum, or urine. (CH)

5388 mRNA TURNOVER STUDIES APPLYING LABELED URIDINE REQUIRE AN EVALUATION OF SPECIFIC RADIOACTIVITIES OF UTP AND RNA-U. Kramer, G.; Wiegers, U.; Hilz, H. (Univ., Hamburg). Biochem. Biophys. Res. Commun.; 55: No. 2, 273-281(16 Nov 1973).

In (^{3}H) uridine labeling experiments as applied for the determination of RNA turnover, several parameters have been widely neglected that influence considerably the interpretation of the data: The specific radioactivity of the UTP pool in HeLa cells attained steady state level only after two to three hours. Even 10^{-5} exogenous (^{3}H) uridine did not guarantee a constant supply of the label in long-term (>6 hrs) experiments as indicated by a decrease in exogenous uridine and a decrease in UTP specific radioactivity. This, however, could be overcome by continuous infusion of (^{3}H) uridine. Pyrimidine nucleotide synthesis de novo was only partially suppressed by exogenous uridine (10^{-5}M caused 55% inhibition). Thus, steady state values of UTP specific radioactivity were considerably lower than those of exogenous uridine. (^{3}H) uridine labeling led to a rather rapid equilibration of the UTP and CTP pools with an equal labeling of U and C in (total) RNA after 6 hrs of incubation. Separation and analysis of individual RNA bases, therefore, are required, when labeling kinetics are to be used to evaluate RNA turnover. (auth)

5389 RADIOIMMUNOASSAY. Spector, S. (Roche Inst. of Molecular Biology, Nutley, NJ). Annu. Rev. Pharmacol.; 13: 359-370(1973).

The principles of radioimmunoassay and its widespread applications are briefly reviewed. (77 references) (ERB)

5390 LABELING OF HUMAN SIDEROPHILIN WITH ^{113m}In. Drouet, J. (Centre National de Transfusion Sanguine, Paris); de Vernejoul, P. pp 438-439 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1973).

The radioisotope ^{113}In can fix itself to human siderophilin (in vivo and in vitro). In this way, it was possible to label purified human plasma siderophilin and to study the stability of the product obtained. The results lead to proposals that this short-lived radioisotope could be used for hemodynamic studies. (FR)

5391 APPLICATIONS OF FLUORESCENT SCANNING TECHNIQUES. Hoffer, P. B. (Univ. of Chicago). Trans. Amer. Nucl. Soc.; 17: 109(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

MATERIALS

Refer also to abstract 6311.

Ceramics and Cermets

Refer also to abstracts 4937, 5429, 5436, 5450, 5462, 5464, 5474, 5538–5540, 5547, 5560, 6845, 6846, 6901, 6921, 6922, 6924, 6925, 7045, 7053, 7230, 7457, and 7459.

5392 (BARC-653) BINARY METAL-OXYGEN PHASE EQUILIBRIUM DIAGRAMS AND CRYSTALLOGRAPHIC DATA. Rajput, B. K.; George, A. M.; Karkhanavala, M. D. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 98p. Dep. NTIS (U. S. Sales Only) $7.00.

Data from the literature are compiled for the phase equilibria of 34 metal–oxygen systems, together with relevant crystallographic data. The O_2 wt % or at. % has been converted into oxygen/metal ratios. The metals in scope include Am, Ce, Cm, Er, Hf, Mo, Nd, Np, Nb, Pu, Pr, Pa, Re, Tc, Tb, Th, W, U, V, Y, and Zr. (39 figures) (DLC)

5393 (BLG-475) FABRICATION OF DISPERSION-STRENGTHENED FERRITIC STEEL TUBES. Noels, J.; Massaux, H.; De Wilde, L. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Feb 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of fabrication, on laboratory scale, of thin-walled tubes in oxide-dispersion-strengthened ferritic steels is described. These alloys are candidate cladding materials for fast breeder reactors and are prepared by powder-metallurgy techniques. Final dimensions of 6/5.2 mm have been obtained by cold drawing extruded hollows with 30/26 mm diameter. (auth)

5394 (CONF-720823-P2, pp 874-876) GOVERNMENT-INDUSTRY CONFERENCE ON ADSORBERS AND ADSORBENTS. Burchsted, C. A. (Oak Ridge National Lab., TN). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A list of candidate materials that may be used as a domestic source of activated carbon is given. The need for additional tests on the proposed materials is suggested. (DHM)

5395 (CONF-731004-3) IRRADIATION PERFORMANCE OF ADVANCED FUELS FOR HTGR's. Coobs, J. H.; Eatherly, W. P.; Scott, J. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 20p. Dep. NTIS $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

Fuel for large HTGR power stations in the United States consists of coated particles of ThO_2 as fertile material mixed with smaller coated particles containing fissile material, either ^{233}U from recycle of bred fuel or ^{235}U as makeup fuel. Recycle fuel particles containing ^{233}U mixed with thorium in sol–gel oxide microspheres have been prepared and experiments in progress will test a fuel compositon consisting of Th/U = 4 to full exposure and burnup. The use of weak-acid ion exchange resin particles as precursors for either type of fissile fuel kernel offers several advantages in processing and properties. Pilot-scale preparation and testing of resin-base fuels demonstrated that their performance is adequate and indicate that such fuels may be capable of operating at temperatures well above 1300°C. Such high-performance fuels are desirable for process heat and direct-cycle applications. (auth)

5396 (CONF-731104-5) MAGNETIC PROPERTIES OF UC–UN SOLID SOLUTIONS. Lander, G. H.; Lam, D. J.; Reddy, J. F.; Mueller, M. H. (Argonne National Lab., Ill. (USA)). 1973. 6p. Dep. NTIS $3.00.

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

Both UC and UN are semi-metallic materials with the NaCl crystal structure and lattice parameters 4.96 and 4.89Å, respectively. UC is nonmagnetic with a susceptibility that is temperature-independent, whereas UN becomes antiferromagnetic at 53°K with ordering of the first kind. Solid solutions of the form $UC_{1-x}N_x$ exist for $0 \leq x \leq 1$. Neutron-diffraction experiments have been performed on five samples with $0.85 \leq x \leq 0.95$. Over this region of x both T_N and the ordered magnetic moment per U atom decrease linearly from T_N = 53°K and 0.75 μ_B for UN (x = 1) to T_N = 30°K and 0.35 μ_B for x = 0.88. The composition x = 0.86 shows no ordering in the neutron experiments. The absence of magnetic order for $x < 0.88$ has been confirmed by magnetization measurements. In the range of x examined the effective paramagnetic moment is 3.25 ± 0.10 μ_B/U atom, close to the value of ~ 3.1 μ_B for UN. (auth)

5397 (EUR-5013) SOME PHASE EQUILIBRIA AND THERMODYNAMIC CONSIDERATIONS FOR IRRADIATED OXIDE NUCLEAR FUELS. Potter, P. E. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Jun 1973. 63p. (CONF-720862-1). Dep. NTIS (U. S. Sales Only) $5.25. EUR B.Fr.70.-.

From meeting on the behavior and chemical state of fission products in irradiated fuels; Vienna, Austria (6 Aug 1972).

The recent published data on the phase equilibria and thermodynamics of the appropriate oxide systems are considered. The binary systems, uranium–oxygen and plutonium–oxygen are considered along with the ternary system uranium–plutonium–oxygen and the systems of the major fission products with uranium–oxygen and plutonium–oxygen. (auth)

5398 (K-1630) FABRICATION OF TUNGSTEN–URANIUM DIOXIDE HONEYCOMB STRUCTURES. Phase I. Summary Report. White, D. E.; Foley, E. M. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 19 Mar 1965. Contract W-7405-eng-26. 58p. (NASA-CR-54255). Dep. NTIS $5.00.

Declassified 28 Aug 1973.

W–20 vol % UO_2 honeycomb structures were successfully made by two fabrication methods. One method involved stacking of individual unsintered hexagonal tubes, followed by isostatic pressing and sintering. The other method formed the unsintered honeycomb as a unit which was then sintered. The sintered structures, consisting of a close array of $1\text{-}^1/_2$ in. long hexagonal channels, had densities ranging from 94 to >97% of theoretical. In addition to honeycomb fabrication, two methods are described for cladding the interior honeycomb surfaces to prevent UO_2 loss during high-temperature operation. (7 tables, 32 figures). (auth)

5399 (K-1636) FABRICATION OF TUNGSTEN–URANIUM DIOXIDE HONEYCOMB STRUCTURES. Phase II. Quarterly Report for Period Ending March 15, 1965. Foley, E. M.; Wagner, R. L.; White, D. E. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 21 May 1965. Contract W-7405-eng-26. 73p. (NASA-CR-54376). Dep. NTIS $5.75.

Declassified 28 Aug 1973.

Emphasis was given to the use of tungsten-clad uranium dioxide particles instead of surface cladding to reduce fuel loss during the fabrication and the high-temperature operation of tungsten–uranium dioxide reactor fuel elements. Two fabrication methods were investigated. In one method individual unsintered hexagonal tubes were stacked, isostatically pressed, and sintered. The other method formed the entire unsintered honeycomb as a unit which was then sintered. Current emphasis is directed toward the latter method which eliminates problems of tube joining and inspection. Results of initial tests of equipment for direct forming of a 163-channel honeycomb with uniform fuel loading are described. (39 figures, 16 tables) (auth)

5400 (K-1647) FINAL REPORT FOR FY 1965 ON TUNGSTEN–URANIUM DIOXIDE MATERIALS FOR NASA. Part I. Preparation of High Purity Uranium Oxide Powders. Part II. Cladding and Joining of Tungsten Cermets by Plasma Spraying. Part III. Tungsten Coating of Uranium Dioxide Particles. Cochran, W. L.; Knight, R. G.; Stanley, F. S. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 11 Oct 1965. Contract W-7405-eng-26. 115p. (NASA-CR-54482). Dep. NTIS $7.75.

Declassified 28 Aug 1973.

Several uranium oxide fuel materials were prepared for evaluation. Included was a 2-pound sample of plasma jet spheroidized, 30- to 60-μ UO_2 of precisely controlled stoichiometry containing less than 50 ppM metallic impurities. Six 1-pound samples of 30- to 60-μ UO_2 were prepared which contained calcium oxide, thorium oxide, or yttrium oxide stabilizing agents in solid solution. These powders were coated with 8 to 10 μ of tungsten by hydrogen reduction of tungsten hexaflouride in a fluidized bed. Seven 1-pound samples of 30- to 60-μ UO_2 containing various concentrations of yttrium oxide in solid solution were also prepared. Finally, a 1-pound sample of less than 5-μ UO_2 containing 10 mole % yttrium oxide was produced. Procedures were developed for applying metallurgically bonded tungsten coatings to the edges of W–UO_2 cermet fuel elements. These coatings were effective in reducing the UO_2 loss in high-temperature tests at NASA. Of several techniques examined for producing a halide-free tungsten coating on 30- to 60-μ UO_2 powder, the most promising were (a) vacuum evaporation of tungsten using electron beam heating, and (b) electrostatically bonding fine WO_2

powder onto the UO_2, followed by conversion to tungsten by hydrogen reduction. (auth)

5401 (K-1648) FABRICATION OF TUNGSTEN–URANIUM DIOXIDE HONEYCOMB STRUCTURES. Final Report for Period Ending June 30, 1965. Foley, E. M.; Wagner, R. L.; White, D. E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 5 Nov 1964. Contract W-7405-eng-26. 117p. Dep. NTIS $8.00.

Declassified 28 Aug 1973.

Honeycomb structures in which uranium dioxide is dispersed in a tungsten matrix were made by two fabrication methods. These are discussed in detail and photographs of units produced by both methods are included. Several sizes of uranium dioxide powder were investigated as possible fuel materials. (73 figures, 25 tables) (auth)

5402 (ORNL-4503(Vol.2)(Rev.)) THORIUM CERAMICS DATA MANUAL. Volume II. Nitrides. Revised. Peterson, S.; Curtis, C. E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

Physical, chemical, and mechanical properties of thorium nitrides, alone and in combination with other nitrides and other thorium compounds, are collected from the literature through January 1973 (51 references). The thorium-nitrogen phase equilibrium is reviewed. Although mechanical property data are still sparse, recent physical and chemical characterization of ThN has confirmed its high metallic conductivity, furnished detail on hydrolysis and oxidation, and expanded the knowledge of the (Th,U)N and Th(C,N) systems. (auth)

5403 (ORNL-4503(Vol.6)) THORIUM CERAMICS DATA MANUAL. Volume VI. Phosphides. Peterson, S. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 6p. Dep. NTIS $4.00.

Property data on thorium phosphides are collected from the literature through 1972 (23 references). Although the characterization is far from complete, enough is known to show that the monophosphide offers a combination of high-temperature stability, electronic conductivity, resistance to air and water, and accommodation of substituted uranium without great sacrifice in properties. (auth)

5404 (PNCT-831-73-01) TOKAI WORKS SEMIANNUAL PROGRESS REPORT, JULY–DECEMBER 1972. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Apr 1973. 111p. Dep. NTIS (U. S. Sales Only) $7.75.

Activities devoted to the development and fabrication of plutonium-bearing fuels, development of centrifugal uranium enrichment technology, construction of the Tokai Reprocessing Plant, and related research and development work are summarized. (JRD)

5405 ELECTRIC FIELD EFFECT ON THE ELASTIC CONSTANT NEAR THE GADOLINIUM MOLYBDATE PHASE TRANSITION. Courdille, J.M.; Dumas, J. (Laboratoire d'Ultrasons, Université Paris VI, Tour 13, 11, quai Saint-Bernard, 75230 Paris-Cedex 05, France). Phys. Rev. B 8: No. 3, 1129-1131 (1 Aug 1973).

The elastic constant c_{11} of gadolinium molybdate varies with the electric field $[c_{11}(E) = c_{11}(E = 0) + \beta_{111}E]$. In the vicinity of the 159 °C ferroelastic phase transition, the critical exponent n, in the variation of coefficient β_{111} with temperature was found to be 1.0 ± 0.2. A shift in the transition temperature, under the action of an electric field, is observed indirectly. (auth)

5406 POSITRON ANNIHILATION IN CERTAIN TRANSITION METAL HYDRIDES. Sabin, V.I.; Andrievskii, R.A.; Gorbachev, V.V.; Tsyganov, A.D. Sov. Phys.-Solid State 14: No. 11, 2815-2817 (May 1973).

The method of angular γ correlation was used to study positron annihilation in yttrium hydride $YH_{1.95}$, zirconium hydride $ZrH_{1.97}$, and niobium hydride $NbH_{0.95}$. It is shown for the case of zirconium hydride that hydrogen affects the nature of the angular γ distribution. The data found support the proton model for the transition metal hydrides. (auth)

5407 SOME FEATURES OF HEXAGONAL BORON NITRIDE. Khusidman, M.B. Sov. Phys.-Solid State 14: No. 11, 2791-2793 (May 1973).

The x-ray emission and absorption spectra of boron and nitrogen in BN are discussed. It is shown that the selective maximum observed in the boron spectra is produced by the partial filling of its $2p_z$ orbitals and therefore by the partial filling of the bottom of the conduction band. The diffuse-reflection method was used to determine the width of the BN forbidden-band, 3.85 ± 0.05 eV. In the 400–600 nm region five selective absorption maxima were observed and these, like the luminescence maxima, are ascribed to the nitrogen vacancies responsible for the ESR absorption. (auth)

5408 SPECIFIC HEATS OF REFRACTORY COMPOUNDS UP TO THEIR MELTING POINT BY RAPID HEATING. Applications to Uranium and Plutonium Oxides. Affortit, C.; Boivineau, J. C. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 51-54(Apr 1973). (In French).

A simple apparatus for directly measuring specific heats up to the melting point of the substance concerned is presented. A rapid heating method adapted to poorly conducting refractory compounds at low temperatures was used. Results obtained for mixed uranium and plutonium oxides are presented. (FR)

5409 PHASE DIAGRAM OF THE $ZnO-WO_3$ SYSTEM. Kislyakov, I. P.; Smirnova, I. N.; Boguslavskaya, G. I. (Moscow Inst. of Fine Chemical Tech.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 9, 1440-1442(1973). (In Russian).

Thermal and x-ray data on the $ZnO-WO_3$ system showed a congruent melting point, at 1230°C, of $ZnWO_4$, which formed a eutectic with 66 mole % WO_3 (m.p. 1010°C) and with 46.5% WO_3 (m.p. 1205°C). Roentgenograms of annealed and quenched samples showed lines of only ZnO, WO_3, and $ZnWO_4$. (MWG)

5410 SELF-DIFFUSION OF CARBON IN NONSTOICHIOMETRIC UC. Makino, Y.; Asahi, K.; Son, P.; Miyake, M.; Sano, T. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 493-500(Aug 1973).

The self-diffusion of C in nonstoichiometric UC was measured, using radioactive tracer and sectioning technique. The diffusion equations finally derived as function of temperature are: (1) For $UC_{0.985}$ $D = 1.7 \times 10^{-2} \exp[-(57.4 \pm 1.8/RT)\text{kcal/mol}]\text{cm}^2/\text{sec}$ over the temperature range of 1,270° ~ 1,600°C. $D = 3.28 \exp[-(77.2 \pm 2.2/RT)\text{kcal/mol}]\text{cm}^2/\text{sec}$ over the temperature range of 1,600° ~ 2,000°C. (2) For $UC_{1.11}$ $D = 9.5 \times 10^{-2} \exp[-(54.2 \pm 2.6/RT)\text{kcal/mol}]\text{cm}^2/\text{sec}$ over the temperature range of 1,640° ~ 2,070°C. The activation energy for migration of C in UC is considered to be about 54 kcal/mol. From the dependence of the diffusion coefficient and the activation energy on C content in UC, it was seen that interstitial C atoms significantly influence the C diffusion in UC, and from this the C diffusion mechanism is judged to be either an interstitial or else an interstitialcy mechanism. (auth)

5411 STRUCTURE AND SOME PROPERTIES OF TITANIUM DIBORIDE MATERIAL WITH 20% TITANIUM CARBIDE. Kislyi, P. S.; Shvab, S. A.; Gaevskaya, L. A.; Neschetnyi, V. A.; Butuzov, S. S. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 35-38(Sep 1973). (In Russian).

A change in grain size, porosity, bending strength, and electrical resistivity of titanium diboride samples with 20% titanium carbide during sintering is studied. (tr-auth)

5412 APPLICATION OF A HIGH-TEMPERATURE TIAN-CALVET TYPE MICROCALORIMETER TO PARTIAL MOLAR ENTHALPY OF MIXING MEASUREMENTS FOR OXYGEN IN PLUTONIUM-BASE OXIDES. Chereau, P.; Dean, G. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 61-64(Apr 1973). (In French).

Direct measurements were performed at 1100°C on the partial molar enthalpy of an oxygen mixture $h^M_{O_2}$. A high temperature, a Tian–Calvet calorimeter was used for measurements on plutonium oxides, PuO_{2-x}, and mixed uranium/plutonium oxides $(U,Pu)O_{2(2\pm x)}$. The results enabled various enthalpies of formation to be determined for different compounds in the Pu–O system, and phase diagrams to be established about the $PuO_{1.7}$ composition. (FR)

5413 MANUFACTURE OF BONDED-PARTICLE NUCLEAR FUEL COMPOSITES. Stradley, J. G.; Sease, J. D. (to United States Atomic Energy Commission). US Patent 3,763,292. 2 Oct 1973. Filed Date 1 Oct 1971. 4p.

A preselected volume of nuclear fuel particles are placed in a cylindrical mold cavity followed by a solid pellet of resin–carbon matrix material of preselected volume. The mold is heated to liquefy the pellet and the liquefied matrix forced throughout the interstices of the fuel particles by advancing a piston into the mold cavity. Excess matrix is permitted to escape through a vent hole in the end of the mold opposite to that end where the pellet was originally disposed. After the matrix is resolidified by cooling, the resultant fuel composite is removed from the mold and the resin component of the matrix carbonized. (Official Gazette)

5414 CARBON–SILICON COATING ALLOYS FOR IMPROVED IRRADIATION STABILITY. Bokros, J. C. (to United States Atomic Energy Commission). US Patent 3,764,469. 9 Oct 1973. Filed Date 24 Mar 1972. 4p.

For ceramic nuclear fuel particles, a fission product-retaining, carbon–silicon alloy coating is described that exhibits low shrinkage after exposure to fast neutron fluences of 1.4 to 4.8×10^{21} n/cm^2 (E = 0.18 MeV) at irradiation temperatures from 950 to 1250°C. Isotropic pyrolytic carbon containing from 18 to 34 wt % silicon is co-deposited from a gaseous mixture of propane,

helium, and silane at a temperature of 1350 to 1450°C. (Official Gazette)

5415 SINTERING OF COMPACTS OF UN, (U,Pu)N, AND PuN. Tennery, V. J.; Godfrey, T. G.; Bomar, E. S. (to United States Atomic Energy Commission). US Patent 3,766,082. 16 Oct 1973. Filed Date 20 Apr 1971. 6p.

A method is provided for preparing a densified compact of a metal nitride selected from the group consisting of UN, (U,Pu)N, and PuN which comprises heating a green compact of at least one selected nitride in the mononitride single-phase region, as displayed by a phase diagram of the mononitride of said compact, in a nitrogen atmosphere at a pressure of nitrogen less than 760 torr. At a given temperature, this process produces a single-phase structure and a maximal sintered density as measured by mercury displacement. (Official Gazette)

5416 GALVANOMAGNETIC INVESTIGATION OF CERTAIN TRANSITION METAL DIBORIDES. Gordon, W. G. Jr. Brooklyn; Polytechnic Inst. of Brooklyn (1973). 92p. University Microfilms Order No. 73-24,765.

Thesis (Ph.D.).

Galvanomagnetic measurements on TiB_2, and ZrB_2 down to liquid-helium temperatures were made to obtain information about the Fermi surfaces and electron concentrations. In order to analyze the experimental results a solution to the Boltzmann equation was developed using the relaxation time approximation and expressions obtained for the Hall coefficient (R) and the transverse magnetoresistance ($\Delta\rho/\rho$). The dispersion relationship was used in which energy depends only on the magnitude of the wave vector (k). From this general spherical model R and $\Delta\rho/\rho$ were derived for the parabolic model. R and $\Delta\rho/\rho$ were also developed from the ellipsoidal model. The Hall coefficients (R) and the transverse magnetoresistivity which results from these models all have the same basic form. The important parameters are $(\Delta n/n) \equiv (n_e - n_h)/(n_e + n_h)$ and $N \equiv [(d\epsilon/dk^2)_2]\ \tau_2/[(d\epsilon/dk^2)_1]\ \tau_1$. N reduces to a ratio of mobilities in the parabolic model. One prediction of the general spherical model is that if $|R/R_0|$ where $R = R|_{H=0}$ decreases from one initially, it must change sign before saturating. For TiB_2 and NbB_2, the experimental results conform reasonably well to the predictions of the general spherical model. No significant anisotropy was detected. Agreement between data and the model is best when $\Delta n/n$ is high (0.8 – 0.9) and N between 10 and 100. This suggests that in TiB_2 and NbB_2 the electronic conduction properties are largely determined by an s-band of spherical shape in k-space. However, no clear sign change of R or saturation is observed in the magnetic field strengths available to us. The mixing in of the d bands superimposed on the s bands may account for the absence of a sign change. The conclusions for ZrB_2 have to be somewhat ambiguous because this crystal was not stoichiometric. These results differ from Piper's in that no significant anisotropy was observed and the magnetoresistance was not quadratic at all field strengths. No sign change or saturation was observed. However, the data curves do show some of the characteristics of the general spherical model, as do Piper's results. It is suggested that spherical bands play a major role in the conduction process of this material. (DLC)

5417 THERMAL EXPANSION OF CORUNDUM STRUCTURE Ti_2O_3 AND V_2O_3. Eckert, L. J.; Bradt, R. C. (Pennsylvania State Univ., University Park). J. Appl. Phys.; 44: No. 8, 3470-3472(Aug 1973).

The thermal expansion coefficients of the corundum-structure oxides Ti_2O_3 and V_2O_3 were measured by elevated-temperature x-ray-diffraction techniques, the former to 300°C and the latter to 1000°C. Compared with corundum, both of these oxides exhibit deviations in their thermal expansion behavior that may be attributed to electronic interactions of the transition-metal cations. (auth)

5418 CONDITIONS OF HIGH-BULK-WEIGHT MoO_3 SPHEROIDAL SUBLIMATES. Belyaevskaya, L. V.; Zelikman, A. N.; Naramovskii, I. V.; Tel'nova, O. M. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 73-78(1973). (In Russian).

Effect of sublimation conditions and the concentration of the MoO_3 on the form and dimensions of the sublimate particles was studied. The conditions under which spherical particles are formed, guaranteeing the production of products with high bulk weight (9.8 to 1.2 g/cm^3), close to the granulometric composition of the MoO_3 from ammonium paramolybdate, were determined. (tr-auth)

5419 DIELECTRIC CONSTANTS OF CURRENT-BLACKENED SINGLE-CRYSTAL YTTRIA-STABILIZED ZIRCONIA. Thorp, J. S.; Buckley, H. P. (Univ. of Durham, Eng.). J. Mater. Sci.; 8: No. 10, 1401-1408(Oct 1973).

The dielectric constants of 8 mol % single-crystal yttria-stabilized zirconia were measured, using both rf and microwave methods, before and after blackening by high-temperature (800°C) electrolysis. For as-grown material, $\epsilon' = 38 \pm 4$ and $\tan\delta = 0.004$. After electrolysis, both the dielectric constant and loss tangent of the current-blackened material increased; this was compared with theoretical predictions for composite dielectrics. The dielectric behavior in the current-blackened material was consistent with the formation of metallic particles; these initially appeared to be spherical but elongated as electrolysis proceeded. (auth)

5420 PRODUCTION OF CERIA. Woodhead, J. L. (to United Kingdom Atomic Energy Authority). US Patent 3,761,571. 18 Sep 1973. Priority date 10 Feb 1970, United Kingdom of Great Britain and Northern Ireland. 10p.

The new manufacturing process controls the physical characteristics of ceria produced from cerium IV hydroxide. A slurry of the cerium IV hydroxide in water is treated with nitric acid and heated until the pH, which is controlled to be ultimately less than 5.4, reaches a steady value. The slurry thus conditioned is dried to give a dry gel powder. (Official Gazette)

5421 HYDRIDES. Mackay, K. M. (Univ. of Waikato, Hamilton, N. Z.). pp 23-76 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on hydrides that is divided into four general classes, ionic or saline hydrides, metallic hydrides, covalent polymeric species, and covalent molecular hydrides. (156 references) (DHM)

5422 BORON. Greenwood, N. N. (Univ. of Leeds, Eng.). pp 665-991 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

A review is presented on boron that includes occurrence in nature; purification; structure; nuclear properties; atomic properties; physical properties; chemical properties; biological activity; and analytical chemistry. Consideration is also given to borides; boranes; carboranes; boron–oxygen boron–nitrogen, boron–phosphorus, boron–arsenic, and boron–antimony compounds; and boron halides. (1400 references) (DHM)

5423 CARBON. Holliday, A. K.; Hughes, G.; Walker, S. M. (Univ. of Liverpool). pp 1173-1294 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; (1973).

A review is presented on carbon that includes production and uses; nuclear properties; physical properties; chemical properties; health hazards; and analytical chemistry. Consideration is also given to carbides; carbon–nitrogen, carbon–oxygen, and carbon–sulfur compounds; and graphite. (458 references) (DHM)

5424 COMPATIBILITY OF BORON AND ALUMINUM NITRIDES WITH LITHIUM SYSTEMS. Morris, A. E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 151(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5425 CENTRAL VOID SIZE IN IRRADIATED MIXED-OXIDE FUEL PINS. Leggett, R. D.; Baker, R. B.; Dutt, D. S.; Pember, L. A. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 175-176(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5426 RAPID SINTERING OF UO_2 IN A GLOW DISCHARGE. Thomas, G.; Freim, J.; Martinsen, W. (Univ. of Oklahoma, Norman). Trans. Amer. Nucl. Soc.; 17: 177(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5427 EFFECTS OF BUBBLE SIZE ON FISSION GAS RESOLUTION. Poeppel, R. B. (Argonne National Lab., IL); Dias, J. W. Trans. Amer. Nucl. Soc.; 17: 182-183(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5428 CRYSTALLOGRAPHIC CHANGES IN FAST-REACTOR-IRRADIATED BORON CARBIDE. Cummings, W. V.; Mahagin, D. E. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 187-188(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5429 CESIUM INTERACTION WITH IRRADIATED OXIDE FUEL PINS. Johnson, I.; Johnson, C. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 194-195(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5430 CHEMICAL STATE AND THERMOMIGRATION BEHAVIOR OF FISSION-PRODUCT CESIUM IN OXIDE FUEL SYSTEMS. Adamson, M. G.; Aitken, E. A. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 17: 195-196 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5431 MODELING URANIUM, PLUTONIUM, AND OXYGEN REDISTRIBUTION IN IRRADIATED OXIDE FUEL BY VAPOR TRANSPORT AND SOLID DIFFUSION. Blackburn, P. E.; Johnson, C. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 196-197(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5432 EFFECT OF OXYGEN ON THE SWELLING OF MIXED-OXIDE FUELS. Plumlee, D. E.; Bohaboy, P. E.; Craig, C. N. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 197(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5433 MEASUREMENT AND SIGNIFICANCE OF THE OXYGEN THRESHOLD FOR OXIDE FUEL–SODIUM REACTIONS. Adamson, M. G.; Aitken, E. A. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 17: 198-199(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5434 KERNAL AGGLOMERATION DURING IRRADIATION OF PuO_2 COATED-PARTICLE FUEL. MacDonald, R. D.; Jeffs, A. T. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 17: 223-225(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5435 OUT-OF-PILE INVESTIGATION OF OXIDE FUEL PELLET SWELLING IN SODIUM: KINETIC ASPECTS OF OXIDE FUEL SODIUM REACTIONS. Adamson, M. G.; Aitken, E. A.; Ludlow, T. E. (General Electric Corp., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 17: 356-357(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Metals and Alloys

Refer also to abstracts 4790, 7045, 7434, 7451, 7459, and 7461.

5436 (ORNL-TM-4355) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1973. Patriarca, P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 179p. AT.
Research progress is reported in sections on development of FBR neutron-absorber materials, steam generator and heat exchanger materials, radiation effects on properties of cladding and structural materials, mechanical properties of structural materials, welding development for FBR components, pipe welding procedures, and nondestructive test development. (JRD)

5437 (ORNL-TM-4424) ISOTOPIC POWER MATERIALS DEVELOPMENT PROGRESS REPORT FOR DECEMBER 1971. Donnelly, R. G. (Oak Ridge National Lab., Tenn. (USA)). 26 Nov 1973. 8p. Dep. NTIS $3.00.
Progress reported includes preparation and tensile properties of Pt–Rh–W alloys, oxidation of Ir, and effects of O_2 and CO on tensile properties of T-111 and TZM. (DLC)

5438 ALUMINIUM, GALLIUM, INDIUM, AND THALLIUM. Wade, K.; Banister, A. J. (Univ. of Durham, Eng.). pp 993-1172 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).
A review is presented on aluminum, gallium, indium, and thallium that includes discovery and history; occurrence and distribution; production and industrial use; purification; nuclear properties; physical properties; chemical properties; toxicity; and analytical chemistry. Consideration is also given to alloys and compounds of aluminum, gallium, indium, and thallium. (281 references) (DHM)

Corrosion and Erosion

Refer also to abstracts 5261, 7410, and 7435.

5439 (CEA-CONF-2375) MOLECULAR ORBITAL EXCITATION OF THE SURFACE ON THE (100) FACE OF MOLYBDENUM. Guillot, C.; Lecante, J.; Riwan, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). 4 May 1973. 10p. (In French). (CONF-730567-2). Dep. NTIS (U. S. Sales Only) $3.00.
From colloquium on the physics and chemistry of surfaces; Brest, France (23 May 1973).
The adsorption of CO, O_2, and N_2 on a (100) Mo crystal face was studied in a LEED apparatus. A retarding-field analyzer was used to obtain the loss spectra given by the electron beam (45 eV to 70 eV) scattered by the clean and gas-covered surface. The characteristic losses observed with CO and O_2 agree with recent photoemission results. (auth)

5440 FIELD EMISSION STUDIES OF THE EFFECT OF SILICON AND CARBON ON TUNGSTEN AND MOLYBDENUM SURFACE SELF-DIFFUSION. Bennum, D. H. Reno, NV; Univ. of Nevada (1973). 57p. University Microfilms Order No. 73-27,495.
Thesis (Ph.D.).
In three of the four possible combinations, i.e., C on W, Si on W, and C on Mo, significant increases in the activation energy for surface self-migration over the values for the pure metals with clean surfaces were found. Only for the case of Si on Mo was the effect on activation energy small. In comparing the different metal-impurity systems with clean metal, several anomalous effects were observed; these are discussed here. (DLC)

5441 PRE-IGNITION PROCESSES IN ZIRCONIUM, TITANIUM, AND ZIRCONIUM HYDRIDE. Zlobinskii, B. M.; Mal'tsev, V. M.; Kurylev, V. V. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 114-116(1973). (In Russian).
Growth of the oxide film on the surface of the Zr, Ti, and ZrH_4 particles was studied under dynamic heating conditions. In the temperature interval from 200 to 300°C for Zr and from 300 to 380°C for Ti, the beginning of a heterogeneous reaction was assumed. With increase of the temperature to 900°C, intensive growth of the thickness of the oxide film occurred. The behavior of the particles of ZrH_4 resembled that of particles of Zr and Ti, but with a complex mechanism. (JSR)

5442 SURFACE STUDIES USING SLOW ELECTRON SPECTROMETRY. Verdier, A. (ONERA, Chatillon-sous-Bagneux, France). Vide; 28: No. 164, 83-85(Mar 1973). (In French).
A magnetic electron spectrometer was developed for studying interaction of slow electrons (0 to 2000 eV) with solid surfaces in the following conditions: the surface is bombarded at normal incidence, and the electrons produced are collected by an immersion objective which focuses them on the entrance slit of the spectrometer. An ion-bombardment system is put in the objective and allows sputtering of the surface. Thus, it is possible to do experiments with electropositive materials: for instance, the oxidation of aluminum may be followed up to two alumina layers. On the other hand, energy losses characteristic of perturbed surfaces have been observed on graphite, copper, and silver. (FR)

5443 EFFECT OF OXYGEN ON THE CORROSION OF V AND V–20% Ti BY LIQUID LITHIUM. DeVan, J. H.; Klueh, R. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 149(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5444 FUSED-SALT CORROSION AND ITS PREVENTION IN FUSION REACTORS. Cantor, S.; Moulton, D. M.; Grimes, W. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 150(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5445 ASSESSMENT OF CORROSION-PRODUCT TRANSPORT PROBLEMS IN A CTR. Johnson, A. B. Jr. (Battelle Memorial Inst., Richland, WA); Vogelsang, W. F. Trans. Amer. Nucl. Soc.; 17: 150-151(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5446 HYDROGEN PERMEATION THROUGH CLEAN AND OXIDE-COATED METALS AT LOW PRESSURES. Savage, H. C.; Strehlow, R. A. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 152-153(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5447 EFFECT OF OXYGEN IN SODIUM ON RADIONUCLIDE RELEASE FROM STAINLESS STEEL. Brehm, W. F.; Grandy, G. L. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 161(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5448 REACTION OF Fe–Cr–Ni ALLOYS WITH OXYGEN-CONTAINING SODIUM. Wu, P. C. S. (Westinghouse Electric Corp., Madison, PA); Chiotti, P. Trans. Amer. Nucl. Soc.; 17: 161-162(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5449 INTERPRETATION OF CLADDING ATTACK IN MIXED-OXIDE ELEMENTS. Lambert, J. D. B.; Strain, R. V. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 192(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5450 FAILURE MECHANISM IN MIXED-OXIDE FUEL ELEMENTS. Lambert, J. D. B.; Neimark, L. A.; Strain, R. V. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 193-194(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5451 INTERACTIONS BETWEEN STRESSED ZIRCONIUM ALLOYS AND IODINE AT 300°C. Wood, J. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 17: 197-198(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Preparation and Fabrication

5452 (CEA-CONF-2446) EFFECT OF BATH CONSTITUTION AND INTERNAL STRESSES ON THE GENERATION OF CRACKS IN THE ELECTRODEPOSITED Ni–Mo ALLOYS. Vu Quang Kinh; Chassaing, E. (Centre National de la Recherche Scientifique, 94 - Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique). [nd]. 14p. (CONF-730566-1). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on electroplating and 70. event of the European Federation of Corrosion; Budapest, Hungary (7 May 1973).

By means of proper composition of the sodium citrate bath and adequate cathode current density, crack-free Ni–Mo coating can be electrodeposited. The effect of current density on internal stress, chemical composition, and critical thickness of the Ni–Mo deposits are investigated. The stress rises quickly with the increasing molybdenum content in the deposits. The sulfamate bath gives higher current efficiency and larger critical thicknesses than the chloride or sulfate baths. The dependence of crack generation on experimental conditions and on some intrinsic parameters of the deposits is discussed. (auth)

5453 (N-73-20590) TECHNIQUES FOR LITHIUM REMOVAL FROM 1040°C AGED TANTALUM ALLOY T-111. Gahn, R. F. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 17p. (NASA-TM-X-2775). NTIS.

Liquid-ammonia and vacuum-distillation techniques were found to be satisfactory for removing lithium from 1040°C aged T-111 (tantalum–8% tungsten–2% hafnium). Results of ductility tests and chemical analysis show that these two methods are adequate for removing lithium without embrittlement or contamination of the T-111. Moist air exposure of T-111 with traces of lithium on the surface produced mixed results. Some specimens were ductile; others were brittle. Brittle T-111 had an increased hydrogen content. Water removal of lithium from T-111 caused brittleness and an increased hydrogen concentration. (auth)

5454 (N-73-24572) FEASIBILITY OF PRODUCING CAST REFRACTORY METAL–FIBER SUPERALLOY COMPOSITES. McIntyre, R. D. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1973. 19p. (NASA-TM-X-2782). NTIS.

A study was conducted to evaluate the feasibility of direct casting as a practical method for producing cast superalloy tungsten or niobium alloy fiber composites while retaining a high percentage of fiber strength. Fourteen nickel-base, four cobalt, and three iron-based matrices were surveyed for their degree of reaction with the metal fibers. Some stress–rupture results were obtained at temperatures of 760, 816, 871, and 1093°C for a few composite systems. The feasibility of producing acceptable composites of some cast nickel, cobalt, and iron-matrix alloys with tungsten or niobium alloy fibers was demonstrated. (auth)

5455 (N-73-24576) DISPERSION-STRENGTHENED NICKEL–YTTRIA SHEET ALLOY PRODUCED FROM COMMINUTED POWDERS. Sikora, P. F.; Quatinetz, M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 18p. (NASA-TM-X-68245). NTIS.

An investigation was conducted to determine whether a nickel matrix with yttria as a dispersoid could be produced by a comminution and blending (wet attrition-NASCAB) approach. Concentration of yttria, powder cleaning temperature, screening (sieving) of the powders, and amount of thermomechanical working were major variables. Tensile strength and stress–rupture life at 1093°C were determined. A product containing 4 vol % Y_2O_3, cleaned at 315 or 371°C with screening, exhibited 1093°C tensile strength equivalent to NASCAB Ni–4ThO_2 and to commercially produced thoriated nickel sheet. (auth)

5456 (RFP-2041) CAN-ROLLING OF BERYLLIUM INGOTS. Floyd, D. R.; Leslie, W. W.; Dolechek, L. F. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 15 Oct 1973. Contract AT(29-1)-1106. 27p. Dep. NTIS $4.00.

Aspects of hot-rolling cast-beryllium billets canned in 304 stainless steel are examined. Emphasis is placed on the development of the proper rolling schedule to completely convert the columnar cast structure to a uniform equiaxed one. Also emphasized are curling difficulties found in rolling this two-metal composite. The curling is found to depend chiefly on friction between the billet and work rolls. Lubrication and roll surface finish are found to be the key variables which in turn control friction. Curling is best prevented by having a higher friction coefficient on the bottom billet surface than on the top during rolling. (auth)

5457 PRODUCTION OF SHEATHING TUBES FOR BREEDER REACTORS. Poetzschke, M.; Ruehle, M.; Schelke, E.; Schneider, L.; Wincierz, P. (to Metallgesellschaft AG). German Patent 1,639,321. 9 Jul 1970. Filed date 16 Jan 1968. (In German).

A process for the production of sheathing tubes for breeder reactors is described in which helicoidal fins detected following cold machining on the smooth tube of a high nickel–iron alloy are characterized by the fact that these fins have stranded pitch and are smooth from the effect of machine removal of material. (TSS)

5458 USE OF VANADIUM-BASED ALLOYS FOR FABRICATION OF FINS AND OF ELEMENTS SUBJECTED TO EQUAL STRESSES IN GAS TURBINES, PARTICULARLY HELIUM TURBINES. Bohm, H.; Ruhle, M.; Wincierz, P. (to Metallgesellschaft AG Gesellschaft fuer Kernforschung mbH). German

Patent 1,946,237. 25 Mar 1971. Filed date 12 Sep 1969. (In German).

Vanadium-base alloys for turbines are described. Composition of the alloy is such that the sum of the elements carbon, nitrogen, and oxygen does not exceed 0.4% and the sum of the elements Ti, Zn, and Hf does not exceed 5% since this material may require plating in the fabrication of blades and pieces subjected equally to constraints in the gas turbine and, in particular, the helium turbines for gas-cooled nuclear reactors. (tr-auth)

5459 PROCESS FOR THE EXPLOSION WELDING OF METALS. Golinelli, P.; Marengo, G.; Montagnani, M. (to EURATOM). German Patent 1,930,244. 17 Dec 1970. Filed date 13 Jun 1969. (In German).

A process is given for explosion welding together of two metallic elements, e.g., an alloy of zirconium and steel. The welding device contains a layer of explosive substance on the welding zone, an igniting apparatus for this layer, an elastic plug between the explosive layer and the welding zone which separates the two metallic elements by such a distance that the energy of shock waves is transformed by the stress of shock, and a metallic layer termination placed intermediately in the welding zone between the two elements and constructed with a material obstructing the diffusion of hydrogen perpendicular to the welding surface. (tr-auth)

5460 FABRICATION PROCEDURES FOR MOLYBDENUM. McDonald, R. E.; DiStefano, J. R.; Moorhead, A. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 153-154(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5461 BRAZING OF MOLYBDENUM. Cole, N. C.; Slaughter, G. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 154(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Properties, Structure, and Phase Studies

Refer also to abstracts 4791, 5548, 6358, 6380, 6732–6734, 6736, 6856, 6857, 6928, 7224, 7416, 7420, 7425, 7430, 7463, and 7468–7471.

5462 (BNWL-SA-4806) TRIODE CATHODIC VACUUM ETCHER FOR THE LOW-VOLTAGE POLISHING AND ETCHING OF METALLOGRAPHIC SPECIMENS. Arrowsmith, H. W.; Allen, R. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 13 Sep 1973. 19p. (CONF-730949-2). Dep. NTIS $3.00.

From international metallography society symposium on specimen preparation for metallography; Los Angeles, California, USA (23 Sep 1973).

A triode cathodic vacuum etcher has been developed that has a number of advantages over conventional diode etchers. The triode etcher can be operated at specimen voltages well below 1000 V(dc) to minimize mount deterioration and the danger of arcing to the etched surface. Etching voltage and current density can be independently varied so that high current densities can be used with low voltages to provide rapid etching rates while minimizing heating of the specimen. Also, redeposition of sputtered material on the etched surface is reduced because of the low operating pressure (<3 millitorr) of the triode system. At very low voltages (75 to 125 V(dc)) the etching rate is relatively insensitive to crystalline orientation and a polishing action is obtained. This permits the removal of deformed surface layers and even such gross surface defects as the scratches from 600-grit paper without producing significant surface relief. This ion polishing capability has been used to reveal the pore structure of UO_2 and UO_2–PuO_2 specimens by removing surface flow material without enlarging the pores. Details of the design and operation of a simple, inexpensive triode cathodic vacuum etcher are presented and its ion polishing and etching capabilities are illustrated for a variety of materials including copper, plutonium, samarium, and uranium oxide. (auth)

5463 (CONF-731105-8) MECHANICAL PROPERTIES OF SEVERAL PRODUCTS FROM A SINGLE HEAT OF TYPE 304 STAINLESS STEEL. McCoy, H. E. Jr.; Waddell, R. D. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 24p. Dep. NTIS $3.25.

From winter meeting of American Society of Mechanical Engineers; Detroit, Michigan, USA (11 Nov 1973).

Tensile and stress-rupture tests were run on several products from a 90-ton heat of type 304 stainless steel. The yield stress of the products in the as-received condition varied from 26,500 to 57,200 psi at 75°F. There were significant differences between the strengths of various products and considerable variation for a single product due to nonuniform residual cold work. Reannealing 0.5 h at 2000°F resulted in yield stresses in the 25,000 to 27,000 psi range; only the properties of the hot-reduced tubing fell below this range. At a test temperature of 1100°F, the as-received products had yield stresses from 14,800 to 35,500 psi. Reannealing caused the yield stresses of all but three products to fall in the range 10,200 to 11,700 psi. Stress-rupture tests at 1100°F on the reannealed products did not reveal significant variation in properties. (auth)

5464 (COO-3084-22) DUCTILE VS BRITTLE BEHAVIOR OF CRYSTALS. Rice, J. R.; Thomson, R. (Brown Univ., Providence, R. I. (USA). Div. of Engineering). May 1973. Contract AT(11-1)-3084. 45p. Dep. NTIS $4.25.

Aspects of the ductile vs brittle response of crystals are examined. Models are proposed for production of dislocations from crack tips in such ways that after expansion of the dislocations under external stress field, automatically sharp cracks are blunted by atomic planes. Various forces operating between cracks and dislocations are considered in two dimensions, and the activation energy is estimated for formation of dislocation half loops from cracks under the influence of these forces when energy barriers exist. An evaluation of experimental results is included. (JRD)

5465 (COO-3175-4) MEASUREMENT OF ELECTRON ENERGY BAND STRUCTURE IN CONDUCTORS. Final Report, January 1970–September 1973. Merrill, J. R. (Dartmouth Coll., Hanover, N. H. (USA)). 1973. Contract AT(11-1)-3175. 8p. Dep. NTIS $3.00.

Progress is reported in studies on tensor magnetoresistivity anisotropy, wave propagation in superconductors, current peaks in thin film superconductive tunneling in junctions, anisotropy of edge gaps in superconductors, plasmon wave behavior, molecular transitions in insulators, minimagnet design, hysteretic effects in NbTi superconducting magnets, rf propagation of plasma waves, and computer time sharing. (JRD)

5466 (LBL-1858) STRUCTURE AND ELEVATED-TEMPERATURE PROPERTIES OF FERRITIC ALLOYS STRENGTHENED BY INTERMETALLIC COMPOUNDS. Bhandarkar, M. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 124p. Dep. NTIS $8.25.

Thesis.

An investigation was conducted to develop high-temperature 1Ta–5Cr, 1Ta–7Cr, and 1Ta–7Cr–0.5 Mo alloys using a dispersion of the Laves phase in a noncarbon-containing, body-centered-cubic iron matrix. An understanding and application of basic principles of materials science and the use of large amounts of information available in the literature were instrumental in the development of Fe–Ta–Cr alloys of the investigation. The phase transformations that occurred in the alloys, and the resulting microstructures were studied. The relations between mechanical properties and structure were also examined. Short-time tensile mechanical properties and long-time creep and stress-rupture tests were conducted on the alloys in which microstructural features were varied by changes in the heat-treating procedure. The mechanical properties were compared with those of several commercially available steels. An examination of substructure and precipitate distribution of the alloys before and after creep tests, the determination of apparent activation energy for creep, and an estimation of the stress sensitivity of steady-state creep rates were carried out in order to investigate the mechanism of creep in dispersion-hardened ferritic alloys. Fracture surface morphology was examined after specimens were tested in short-time tension and in creep. (JRD)

5467 (LBL-2200) COMPUTER SIMULATION OF FRANK LOOP CONTRAST IN FIELD ION IMAGES. Stolt, K. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 148p. Dep. NTIS $9.50.

Thesis.

A computer model for simulation of the image contrast caused by Frank dislocation loops in field ion tips of fcc materials is presented. The model is based on the shell model for ion image simulation, whereas the displacement field of Frank loops is computed from the exact displacement equation for a closed dislocation loop in an isotropically elastic continuum. A method for taking surface effects into account by superposition of the displacement field of an image loop is introduced. The results indicate that Frank loops will cause image contrast while wholly beneath the surface of the tip, and that vacancy and interstitial loops will cause qualitatively different contrast. The effect of surface re-

laxation, while quantitatively substantial, does not qualitatively alter these results. Special emphasis is placed on small loops, with respect to which existing contrast theory is inadequate. Some micrographs of ion bombarded iridium tips are presented. These micrographs display contrast effects in excellent agreement with computer plots of interstitial loop contrast. (51 figures, 42 references) (auth)

5468 (MLM-2066) ANALYTICAL METHOD FOR THE ANALYSIS OF FERROVANADIUM. Zanotelli, W. A. Jr. (Mound Lab., Miamisburg, Ohio (USA)). 17 Oct 1973. Contract AT-33-1-GEN-53. 49p. Dep. NTIS $4.50.

Thesis. Submitted to Univ. of Cincinnati.

A method was developed for the analysis of vanadium in ferrovanadium and copper–vanadium systems. The method incorporates the optimum conditions for ethylene-glycol-bis-(β-aminoethyl ether)-N,N,N′,N′-tetraacetic acid (EGTA) and H_2O_2 and the masking agent, NH_4F. The pH for the method is 1.7. The absorption data are collected at 425 mμm. The individual analysis for ferrovanadium agrees within 1.0% and the average agrees within 0.5% of the NBS standard. The copper–vanadium analysis shows an average relative error of 3.55%. This method for the analysis of vanadium using EGTA is sensitive; this is indicated by the molar absorptivity value of $\epsilon = 428$. The method using EGTA is more sensitive than methods using acetic acid (ethylenedinitrile) tetra- (EDTA) as indicated by the molar absorptivity $\epsilon = 428$ for EGTA and $\epsilon = 325$ using EDTA. (JRD)

5469 (N-71-13464) FORMATION OF SURFACE FILMS BY ELECTRON BOMBARDMENT. Final Report, October 1969–September 1970. Roberts, M. W.; Ross, J. R.; Wood, J. H.; Murphy, W. J.; Frost, S. J. (Bradford Univ. (UK). School of Chemistry). Oct 1970. Contract NAS7-717. 77p. (NASA-CR-115848). NTIS.

For TRW Systems Group, Redondo Beach, Calif.

Mechanism of formation and properties of thin organic polymeric films prepared by electron-beam polymerization are considered. Work carried out to characterize the reactions occurring in the tungsten emitting filament during the polymerization process is described; both W_2C and WC are formed, and changes occur in the apparent thermionic work function of the emitter. Although the thermionic work function of the carburized tungsten is much lower than that of tungsten, it is shown that the average work function is higher. Characterization of rhenium as an emitting filament is also discussed. Although rhenium has previously been thought not to form carbides, the present results indicate that a carbide is formed. Results of studies of the surface properties of thin polymer films prepared under various conditions from perfluorobutene-2 are presented. Variation of the reaction conditions causes very considerable changes in the surface characteristics. (auth)

5470 (N-73-20588) COMPOSITION EFFECTS ON MECHANICAL PROPERTIES OF TUNGSTEN–RHENIUM–HAFNIUM–CARBON ALLOYS. Witzke, W. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1973. 26p. (NASA-TN-D-7210). NTIS.

The mechanical properties of rod and sheet fabricated from arc-melted W–4Re–Hf–C alloys containing up to about 0.8 mole % hafnium carbide (HfC) were evaluated in the as-worked condition. The ductile–brittle transition temperatures of electropolished bend and tensile specimens were independent of HfC content in this range but dependent on excess Hf or C above that required for stoichiometric HfC. Low-temperature ductility was a maximum at Hf contents slightly in excess of stoichiometric. Variations in high-temperature strength were also dependent on excess Hf and C. Maximum creep strengthening also occurred at Hf contents in excess of stoichiometric. Analysis of extracted second-phase particles indicated that creep strength was reduced by increasing WC content in the HfC particles. (auth)

5471 (ORNL-TM-4292) ANALYSIS OF STRESS–STRAIN BEHAVIOR OF TYPE 316 STAINLESS STEEL. Fahr, D. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

Engineering stress-strain curves of annealed, cold-worked, and aged type 316 stainless steel were analyzed qualitatively. Atom-defect interactions were related to work-hardening rates and tensile data on the basis of serrations occurring in such stress-strain curves. Three types of serrations have been identified. The effect of varying strain rate was studied by varying crosshead speeds from 0.002 to 2 in./min in room-temperature tests and tests at 650°C. Only at 650°C had the crosshead speed a significant influence on the ultimate tensile strength and uniform plastic strain; yield strength and elongation values varied little with strain rate. The effect of test temperature ranging from 450 to 650°C was studied on as-annealed, annealed and aged, 20% cold-worked, and cold-worked and aged specimens. Specimens aged for 4000 h were tested at their aging temperatures. Long-term aging at 450 and 550°C had little or no effect on mechanical-property data of as-annealed specimens, but affected those of previously cold-worked specimens measurably. Aging as-annealed specimens for 4000 h at 450°C did not lead to precipitation; at 550°C grain boundary precipitation took place; and at 650°C many precipitate particles crystallographically related to the matrix could be observed within the grains and at their boundaries. This precipitate structure led to an increased yield strength and was markedly different from that found in the recrystallized portion of cold-worked specimens aged at 650°C. Cold work facilitated precipitation and the formation of large σ-phase particles. Results of the effect of short-time (10-h) aging on room-temperature tensile data, and of the influence of varying amounts of tensile prestrain on tensile data of specimens subsequently aged 4000 h and tested at 650°C, are also included. (auth)

5472 (RD/B/N-2625) DIFFUSION OF CHROMIUM IN TYPE 316 STAINLESS STEEL. Smith, A. F. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Chromium diffusion plays an important role in the oxidation behavior of stainless steels. In a study of the diffusion behavior of the principal constituents of Type 316 stainless steel used in AGR reactors, the lattice and grain-boundary diffusion coefficients of ^{51}Cr were measured. Lattice diffusion in the temperature range 750 to 1200°C is described by: $D_L = (6.32^{+1.1}_{-0.88}) \times 10^{-2}$ exp $(-58.0 \pm 0.8/RT)$ cm^2 sec^{-1}. Grain-boundary diffusion in the temperature range 650 to 1000°C is given by: $\delta D_B = (1.52^{+0.9}_{-0.71}) \times 10^{-6}$ exp $(-45.7 \pm 3.8/RT)$ cm^3 sec^{-1}. Dislocation-pipe diffusion effects were observed on the near-surface concentration profile below 700°C and also at deep penetrations above this temperature. (auth)

5473 (RDT-M-9-1-T(10-73)) NICKEL–CHROMIUM–IRON AND AUSTENITIC CHROMIUM–NICKEL ALLOY SEALS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Oct 1973. 8p. RSO.

A standard prescribing requirements for Ni–Cr–Fe and austenitic Cr–Ni alloy seals for nuclear and associated applications is presented. This standard supersedes RDT-M-9-1T and RDT-M-9-2T, dated February 1969. (JRD)

5474 (UCLA-34-P-201-5) FOURIER SPACE COMPUTER SIMULATION OF CRYSTALLINE IMPERFECTIONS. Second Annual Progress Report, January 1, 1973–December 31, 1973. de Fontaine, D. (California Univ., Los Angeles (USA). Dept. of Materials). Oct 1973. 34p. (UCLA-ENG-7379). Dep. NTIS $3.75.

Results of research on the kinetics and dynamics of clustering and ordering of crystal defects leading to various types of phase transformations are presented. Summaries of work are included on the method of lattice waves, crystalline defect clusters and kinetics of vacancy movement in irradiated materials. A list of talks and publications related to the contract work is also included. (JRD)

5475 (UJV-3012-M) PLASTIC DEFORMATION MECHANISM IN Mg–2% Be. Haslingerova, I.; Saxl, I.; Cech, B. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Sep 1973. 50p. (In Czech). Dep. NTIS (U. S. Sales Only) $4.50.

Results of tensile tests in the range 20 to 500°C on magnesium composite rods are described. After mechanical treatment and recrystallization, a pronounced texture was discovered. Deformation mechanism and its relation to the preferred orientation were investigated. Mechanical properties were found to be affected by working and recrystallization textures. Nonbasal slip is proposed as the major operating deformation mechanism. (auth)

5476 MEASUREMENT OF A CRITICAL EXPONENT BY A NEW ZERO-FIELD TRANSMISSION-RESONANCE TECHNIQUE. Manikopoulos, C. N.; Sheng, P.; Carver, T. R. (Joseph Henry Laboratories of Physics, Princeton University, Princeton, New Jersey 08540). Phys. Rev. B 8: No. 3, 1131-1140(1 Aug 1973).

The critical exponent β of Ge is measured directly for the first time by a new technique of ferromagnetic transmission resonance in zero external field. The technique consists of measuring the microwave power transmitted through a thin Gd film (47 μ) as a function of temperature. Analysis of the resulting line shape yields the value of conductivity $\sigma = 0.745 \times 10^{16}$ sec^{-1}, spin relaxation time $\tau = 7.3 \times 10^{-11}$ sec, Curie temperature $T_C = 295$°K, and critical exponent $\beta = 031 \pm 0.05$. (auth)

5477 NUCLEAR-SPIN RELAXATION AND KNIGHT SHIFT IN TRANSITION METALS. Ganguly, B.N. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 8: No. 3, 1055-1060 (1 Aug 1973).

The electron–phonon enhancement of electronic specific heat and the effective Coulomb enhancement of spin susceptibility are taken into account, the former through the Eliashberg–McMillan theory of superconductivity for transition metals and the latter through gyromagnetic effect experiment, in calculating the nuclear–spin relaxation rates in transition metals. The nuclear–spin relaxation rate of vanadium determined experimentally is found to be consistent with the conjecture that the observed Knight shift is almost entirely due to orbital paramagnetism. Inclusion of the above corrections gives better qualitative agreement with observed relaxation rates for V, Nb, and Pt. (auth)

5478 NUCLEAR-MAGNETIC-RESONANCE STUDY OF THE ELECTRONIC TRANSITION IN NEAR-EQUIATOMIC V–Ru ALLOYS. Welsh, L.B. (Department of Physics, Northwestern University, Evanston, Illinois 60201); Chu, C.W. Phys. Rev. B 8: No. 3, 1026-1031 (1 Aug 1973).

For the near–equiatomic V–Ru alloys (46–50–at.% Ru) Chu et al. have observed dramatic changes in the electronic properties of these alloys with an accompanying tetragonal crystallographic distortion. Using the V^{51} nuclear magnetic resonance as a probe of the electronic properties, we have studied the Knight shift K and spin–lattice relaxation rate R in the high–temperature cubic phase and low–temperature tetragonal phase. The dramatic decrease in R and increase in K from the cubic to tetragonal phases are strongly concentration dependent. These results correlate well with the strongly concentration–dependent results for the bulk electronic properties. An analysis of the NMR and susceptibility data shows that the change in the electronic properties from the cubic to tetragonal phases results from a dramatic decrease of the d–electron density of states at the Fermi energy, and that R and K are dominated by the d–orbital contributions. (auth)

5479 X-RAY ($N_{IV,V}$) EMISSION SPECTRA OF LANTHANUM AND CERIUM. Fomichev, V.A.; Gribovskii, S.A.; Zimkina, T.M. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 15: No. 1, 138-140 (July 1973).

The $N_{IV,V}(4d)$ x–ray emission spectra of lanthanum and cerium were determined in the wavelength range 60–160 Å. A strong self–absorption was observed in these spectra. The spectrum of La included narrow lines whose energy positions were in agreement with the $N_{IV,V}$ lines in the absorption spectrum of lanthanum. It was assumed that these lines were due to the reemission of electrons excited by the electron bombardment from the 4d subshell to the vacancies in the 4f subshell. A similar but less pronounced effect was observed also in the spectrum of Ce. A considerable proportion of the $N_{IV,V}(4d)$ x rays emitted from La and Ce had energies exceeding the ionization threshold of 4d electrons. (auth)

5480 MAGNETIC RESONANCE AT NUCLEI OF RARE-EARTH IONS HAVING A NONMAGNETIC DOUBLET GROUND STATE. Vaisfel'd, M.P.; Teplov, M.A. (V. I. Ul'yanov–Lenin Kazan' State University). Sov. Phys.–Solid State 14: No. 9, 2243-2245 (Mar 1973).

The possible observation of a magnetic resonance involving nuclei of rare earth ions whose electronic ground states are nonmagnetic Γ_3 doublets in cubic crystals is discussed. It is shown for the case of Tm^{3+} ions that the magnetic–resonance spectrum is governed by dynamic as well as static interactions of ions with their surroundings. In the limiting case of weak dynamic interactions, the magnetic–resonance spectrum of the Tm^{3+} ion is described by a spin Hamiltonian having an effective spin of S=3/2. In the case of sufficiently strong dynamic interactions, the spin Hamiltonian has the usual form for spin I=1/2. The theoretical predictions agree well with experimental NMR data for Tm^{169} nuclei in the intermetallic compound $TmAl_2$. (auth)

5481 HALL EFFECT IN GADOLINIUM IN FIELDS UP TO 46 kOe AT LIQUID–HELIUM TEMPERATURES. Galkina, O.S.; Lazareva, L.V.; Trubitsin, V.A. (M. V. Lomonosov Moscow State University). Sov. Phys.–Solid State 14: No. 9, 2224-2226 (Mar 1973).

The Hall effect was investigated in polycrystalline gadolinium with $\rho(293°K)/\rho(4.2°K) = 45$. The investigation was carried out at 4.2°K in fields up to 46 kOe. It was found that the spontaneous (magnetic) Hall coefficient was $R_s = -4.28 \cdot 10^{-11}$ Ω·cm·G^{-1} and the normal coefficient was $R_0 = -7.6 \cdot 10^{-13}$ Ω·cm·Oe^{-1}. An estimate was obtained of the change in the number of carriers per atom. (auth)

5482 PROFILE OF THE ESR LINE OF LOCALIZED SPINS IN METALS. Al'tshuler, T.S.; Garifullin, I.A.; Kharakhash'yan, E.G.; Shatrukov, L.F. (Kazan' Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Phys.–Solid State 14: No. 9, 2213-2216 (Mar 1973).

A general analytic method for the ESR spectrum of localized spins in bulk metal samples is developed. This method, which is based on the Kramers–Kronig relations, can be used to separate from the observed mixed signal $\chi_A = \chi + \chi'$ the pure absorption line χ' of an arbitrary form. The theoretical relationship between χ_A and $\chi_S = \chi' - \chi''$ was verified experimentally for ESR spectra of paramagnetic La–Gd solid solutions. It is demonstrated that a Gaussian contribution to the ESR line profile of metals can be large. (auth)

5483 TRANSPORT PROPERTIES OF SCANDIUM AT HIGH TEMPERATURES. Zinov'ev, V.E.; Chupina, L.I.; Gel'd, P.V. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 14: No. 9, 2416-2418 (Mar 1973).

The electrical resistivity (range 290–1300°K) and the thermal diffusivity (range 900–1500°K) of scandium have been measured and the carrier scattering mechanism is discussed. (AIP) (auth)

5484 HIGH-TEMPERATURE TRANSPORT PROPERTIES OF GADOLINIUM. Zinov'ev, V.E.; Gel'd, L.P.; Chuprikov, G.E.; Epifanova, K.I. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 14: No. 9, 2372-2374 (Mar 1973).

The electrical resistivity (range 290–1200°K) and the thermal diffusivity (range 900–1500°K) of gadolinium have been measured and correlations are made to carrier scattering mechanisms. (AIP) (auth)

5485 DETERMINATION OF THE KINETIC CHARACTERISTICS OF THE DESORPTION OF LANTHANUM AND NEODYMIUM ATOMS AND IONS FROM THE (001) FACE OF TUNGSTEN BY THE TEMPERATURE MODULATION METHOD. Ionov, N.I.; Marinova, T.S.; Yakshinskii, B.V. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 14: No. 11, 2717-2720 (May 1973).

An additional analysis was made of a recently proposed method for the determination of the kinetic characteristics of the desorption of atoms and atomic ions from the surface of a homogeneous adsorbent. The capabilities of the method were demonstrated by a study of the thermal desorption of lanthanum and neodymium atoms and ions from the surface of a textured tungsten ribbon oriented preferentially in the (001) plane. The heats of desorption of the atoms and ions were determined and found to be $l_0 = 6.1 \pm 0.2$ eV and $l_+ = 7.1 \pm 0.3$eV for lanthanum and $l_0 = 3.3 \pm 0.1$ eV and $l_+ = 4.2 \pm 0.2$ eV for neodymium. The preexponential factors in the expressions for the rates of desorption of atoms and ions were found, to within an order of magnitude, for lanthanum (10^{14}sec^{-1}) and neodymium (10^{8} sec^{-1}). The average lifetimes of atoms in the adsorbed state were determined at several temperatures. (auth)

5486 ABSORPTION SPECTRUM OF TERBIUM IN THE ULTRASOFT X-RAY REGION. Gribovskii, S.A.; Zimkina, T.M. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 15: No. 1, 217-218 (July 1973).

The absorption spectrum of terbium was determined in the energy range 50 to 500 eV in order to fill the gap in the reported spectra of rare–earth metals of the lanthanum group. A comparison of the published experimental data and the theoretical calculations performed in the course of quantitative interpretation of the absorption spectra made it possible to refine the general relationships governing the nature of the absorption of rare–earth metals in the ultrasoft x–ray region. (auth)

5487 ELASTIC CONSTANTS IN SINGLET GROUND-STATE SYSTEMS: PrSb AND Pr. Lüthi, B.; Mullen, M.E. (Physics Department, Rutgers University, New Brunswick, New Jersey 08903); Bucher, E. Phys. Rev. Lett. 31: No. 2, 95-98 (9 July 1973).

The effect of crystal–field levels on the elastic constants has been measured for the singlet ground–state system PrSb. The results can be accounted for quantitatively. Elastic–constant measurements in double–hexagonal close–packed Pr reveal also strong crystal–field effects. (auth)

5488 DEVELOPMENT OF DIFFERENTIAL ENTHALPIC ANALYSIS. Radenac, A.; Berthaut, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 43-50(Apr 1973). (In French).

The utilization of differential calorimetry for phase transformation studies is briefly reviewed together with the apparatus used. The accuracy obtainable after calibration is discussed. The field of application and temperature range covered are indicated. Examples of applications are given, including measurement of heats of formation for uranium allotropes. (FR)

5489 DISLOCATION STRUCTURE IN DEHYDROGENATED NIOBIUM. Amano, M.; Sasaki, Y. (National Research Inst. for Metals, Tokyo). Phys. Status Solidi (a); 19: No. 2, 405-414(16 Oct 1973).

Dislocation structures and mechanical properties of dehydrogenated niobium specimens were investigated by means of transmission electron microscopy and tensile testing. Dehydrogenated specimens were prepared by vacuum annealing of a Nb–30 at.% H alloy. The traces of hydride plates were formed with tangled dislocations in a specimen dehydrogenated at lower temperatures, and the flow stress of such a specimen was very high. It is concluded that the high flow stress of the dehydrogenated specimen is due to the high density of dislocations and their heterogeneous distribution. The probable mechanism of the hydride formation is proposed. (auth)

5490 ISOCHROMAT SPECTROSCOPIC LOCALIZATION OF THE FERMI EDGE IN THE CONDUCTION BAND OF METALS. Mechelke, G.; Ulmer, K. (Univ., Karlsruhe, Ger.). Phys. Status Solidi (a); 19: No. 2, 573-582(16 Oct 1973).

An x-ray spectroscopic method for the exact determination of the Fermi edge within the conduction band of metals is given and applied to isochromat measurements of palladium and molybdenum. The procedure approximates the electronic density of states curve Z(E) in the vicinity ($-3\ k_BT \lesssim E - E_F \lesssim 3\ k_BT$) of the Fermi edge E_F by a linear function of energy E. Bremsstrahlisochromats are computed for two different target temperatures, taking into account the finite energy resolution of the x-ray spectrometer. The application of this method to palladium allows a precise statement concerning the position of the Fermi edge. As to molybdenum, there appears an additional dependence on temperature, rendering application of the method difficult. Possibly this difficulty is correlated with a general dependence on temperature of the density of states, exceeding the dependence described by the Fermi function. (auth)

5491 MAGNETIC PROPERTIES OF Pr_3In. Stalinski, B. (Inst. of Low Temperatures and Structural Research, Wroclaw); Czopnik, A.; Iliew, N.; Mydlarz, T. Phys. Status Solidi (a); 19: No. 2, K161-K164(16 Oct 1973).

The magnetic properties of Pr_3In at 4.2 to 300°K and in applied fields ≤ 80 kOe were investigated. Data are presented graphically on the temperature dependence of magnetization. The experimental results are consistent with induced-ferromagnetism models; however, complete explanation of Pr_3In magnetic behavior requires an extension of single-crystal measurements and neutron-diffraction experiments conducted in magnetic fields. (JRD)

5492 ELECTRICAL RESISTIVITY OF $RESn_3$ SINGLE CRYSTALS (RE = La, Ce, Pr, AND Nd). Stalinski, B.; Kletowski, Z.; Henkie, Z. (Inst. of Low Temperatures and Structural Research, Wroclaw). Phys. Status Solidi (a); 19: No. 2, K165-K168(16 Oct 1973).

The effects of 4f electrons on the electric properties of $RESn_3$ compounds were examined (RE denotes La, Ce, Pr, or Nd). Results of conductivity measurements performed on single crystals along the [001] direction at 2 to 300°K by dc methods are presented graphically and analyzed. (JRD)

5493 ABSORPTION AND DIFFUSION OF HYDROGEN AND DEUTERIUM IN TANTALUM AT LOW TEMPERATURES. Guil, J. M.; Hayward, D. O.; Taylor, N. (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), Ser. A; 335: No. 1601, 141-161(30 Oct 1973).

The kinetics of absorption of hydrogen and deuterium into a tantalum wire have been investigated in the temperature range 78 to 230°K. At pressures greater than about 0.1 Pa the rate or absorption is controlled by diffusion into the metal and the amount of hydrogen or deuterium absorbed is proportional to the square root of time. Diffusion is thought to occur mainly in the β phase, which is formed just beneath the surface of the filament. Very large isotope effects are observed at low temperatures, the ratio of the diffusion coefficients for hydrogen and deuterium being approximately 220 at a temperature of 78°K. This ratio diminishes as the temperature is increased and above 160°K it is constant at a value of 3.5. The Arrhenius plots for diffusion of hydrogen and deuterium both show abrupt changes in slope. The activation energy for diffusion of hydrogen is 8.1 kJ mol^{-1} at temperatures below 110°K, 14.1 kJ mol^{-1} between 110 and 160°K, and 20.3 kJ mol^{-1} at higher temperatures. For deuterium the activation energies are 12.7 kJ mol^{-1} below 118°K and 20.2 kJ mol^{-1} above this temperature. The limiting jump frequencies calculated for diffusion at low temperature are anomalously small and this is thought to indicate that tunneling occurs between adjacent sites. A proton (or deuteron) band model of the solid is used and a rough calculation is made of the frequency of tunneling in the various bands. (auth)

5494 CHANGE IN PROPERTIES OF HARD ALLOY WC–Co WITH DEFORMATION AND RETURN OF THESE PROPERTIES IN ANNEALING. I. Ivensen, V. A.; Chistyakova, V. A.; Eiduk, O. N. (All Union Scientific-Research and Design Inst. of Solid Alloys and Refractory Metals, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 39-45(Sep 1973). (In Russian).

Some physical and mechanical properties of the hard alloy WC–Co as affected by preliminary deformation are considered. It is shown that deformation of WC–Co alloys by a uniaxial compression results in an increase in coercive force, electrical resistivity stress at the beginning of yield, width growth of x-ray-diffraction lines for carbide and cobalt phases, and decrease of bending strength. The change in these properties is established to depend on the alloy structure and composition. The observed changes in the properties are explained by simultaneous development of the processes of hardening and loss of hardness in deformation of the hard alloy. (tr-auth)

5495 EFFECT OF POROSITY ON MECHANICAL PROPERTIES OF MATERIALS OBTAINED BY THE METHODS OF POWDER METALLURGY. Shcherban, N. I. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 57-73 (Sep 1973). (In Russian).

A formula describing the effect of porosity within the whole range of its changes on the mechanical properties of sintered materials is obtained analytically and confirmed by experimental data. A procedure is proposed for plotting the mentioned dependence in presence of a limited quantity of experimental data. The relation between the proposed formula with the already known ones is found. (41 references) (tr-auth)

5496 STUDY OF THE COMPOSITION B–Ti AND SiC–Ti STABILITY WITH LONG HEATING IN VACUUM. Burykina, A. L.; Dzyadykevich, Yu. V.; Gorskii, V. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 74-76(Sep 1973). (In Russian).

By the methods of metallography, x-ray-spectral, and microdurometric analyses, interactions of boron and silicon carbide fibers with a tungsten core and titanium matrix were studied at 900°C during 300 hrs. The boron fiber was established to interact with the tungsten core and form borides WB_2 and W_2B_5. The fiber of silicon carbide does not interact with the tungsten core. In the contact zone of the boron and silicon carbide fibers with the titanium matrix, TiB2 and Ti_3Si, respectively, are formed. (tr-auth)

5497 EFFECT OF NIOBIUM CARBIDE ON PROPERTIES OF TUNGSTEN-FREE HARD ALLOYS. Samsonov, G. V.; Vitryanyuk, V. K.; Voronkin, M. A.; Lomakin, G. K. (Kiev Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 83-86(1973). (In Russian).

Physicomechanical properties of the hard alloy TiC–Ni–Mo (with content 2, 5, 10, and 25 mol.% relative to TiC) were studied as affected by its carbide phase alloying with niobium carbide. It is shown that an increase in the NbC content favors a rise in the bending strength to 132 kg/mm^2 and impact strength at practically unchanged hardness (91 HRA), which is explained by some rise in the grain plasticity of the solid phase presenting the complex carbide TiC–NbC. (tr-auth)

5498 FORMATION OF ELECTRICAL CONTACTS FROM SILVER–ZIRCONIUM PSEUDOALLOY. Braterskaya, G. N.; Kryzhanovskaya, R. I.; Teodorovich, O. K. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 9, 16-20(Sep 1973). (In Russian).

The production technique and properties of sintered Ag–Zr pseudoalloy are considered. Choice of the most optimum technological variant for production of the pseudoalloy with 3% Zr resulted from the investigations. The effects of sintering temperature, pressure, and time on the properties of the alloys are described. Electric contact properties were investigated for the Ag–3% Zr pseudoalloy. (tr-auth)

5499 INTERACTION BETWEEN ALUMOSILICATE COATING AND SOME METALS. Aivazov, V. Ya.; Grosheva, V. M.; Karpinos, D. M.; Listovnichaya, S. P.; Parakhina, E. M. (Inst. of Problems in Materials Science, Kiev). Porosh. Met.; Akad. Nauk Ukr. SSR; No. 9, 30-34(Sep 1973). (In Russian).

The interactions of an alumosilicate coating 0.3-μ thick with different metallic surfaces (Ni, Co, steel X18H9T, Mo, W) was studied within a temperature range of 700 to 1400°C. A possibility is shown to obtain alumosilicate coatings with composition, close to mullite, by the method of electron-beam evaporation of rods made of synthetic mullite. The following methods of the investigation were used: ir spectroscopy, electronic and optical microscopy, and refractroscopy. Limit temperatures of compatibility were determined for alumosilicate films that get into contact with different metal surfaces. It is suggested that the appearance of an addition band within a region of 1500 to 1400 cm^{-1} is caused by the polarizing effect of the metal backing on the vibration spectrum of the film. (tr-auth)

5500 STUDY OF MAGNETIC SUSCEPTIBILITY IN In–Bi ALLOYS. Kuz'menko, P. P.; Suprunenko, P. A.; Kotikova, T. D.; Nikitenko, V. G. (Kiev State Univ.). Metallofizika; No. 44, 77-80 (1973). (In Russian).

From the temperature dependence of the magnetic susceptibility of In–Bi alloys, a correspondence was established for the solidus and liquidus points in the literature phase diagram. The presence of the intermetallic compound In_3Bi_2 was not confirmed. The composition dependence of the magnetic susceptibility of the solid alloys indicates a significant deviation from the law of additivity. The chemical compounds In_2Bi and InBi (solids) appear as extremum points on the magnetic susceptibility–composition curve. The magnetic susceptibility for alloys in the liquid state hardly changes with composition. Values of the magnetic susceptibility

of In alloys with additions of up to 50 at.% Bi are close for liquid and solid states. It is proposed that, in this region of composition, a metallic bond is formed because of the external electrons of the components and that, on melting of these alloys, the electron structure does not undergo substantial change. (tr-auth)

5501 PHASE TRANSFORMATIONS IN Nb–16 TO 40% Zr ALLOYS ABOVE THE MONOTECTOID TEMPERATURE. I. Flewitt, P. E. J. (Central Electricity Generating Board, Cockfosters, Eng.). Acta Met.; 22: No. 1, 47-63(Jan 1974).

An investigation was conducted to establish the precipitation processes that occur on aging metastable β-phase specimens above the monotectoid temperature (T_{mono}). The precipitation was studied by optical and electron microscopy together with electron and x-ray diffraction. Spinodal decomposition of metastable β was confirmed in the initial stages by direct observation of modulations and the presence of side bands to main reflections in electron and x-ray diffraction patterns. The upper temperature limit of this coherent spinodal decomposition $T_s^{\dagger}$ varies with composition and agrees closely with that predicted by the model proposed by Cahn. Initial compositional modulations form on {100} planes to give two coherent regions, one enriched and one depleted in zirconium. The morphology of the spinodal product is an interlocking network of ⟨100⟩ axis rods. The wavelength increases with aging time and obeys a $t^{\frac{1}{3}}$ coarsening law. As the wavelength increases eventually coherency is lost between the two phases and {100} interfacial planes develop. The dislocation networks at these semicoherent interfaces comprise two sets of a ⟨100⟩ dislocations in edge orientation and one set of a ⟨110⟩ dislocations. Concurrent with the coarsening of the spinodal decomposition product, cellular phase separation of equilibrium composition $\beta_{Nb} + \beta_{Zr}$ occurs at grain boundaries. A hardness increase is associated with the spinodal decomposition and the magnitude is of the order of that predicted by coherency strain hardening. Aging within the monotectoid loop but above $T_s^{\dagger}$ results in heterogeneous precipitation of equilibrium composition β_{Zr} phase particles together with cellular $\beta_{Nb} + \beta_{Zr}$ separation. (auth)

5502 PHASE TRANSFORMATIONS IN Nb–16 TO 40% Zr ALLOYS ABOVE THE MONOTECTOID TEMPERATURE. II. Flewitt, P. E. J. (Central Electricity Generating Board, Cockfosters, Eng.). Acta Met.; 22: No. 1, 65-79(Jan 1974).

Following the investigation of precipitation that occurs on aging metastable β-phase specimens above the monotectoid temperature, the precipitation which occurs below this temperature is now described. When quenched from the single-phase β solid solution and aged at lower temperatures decomposition to the equilibrium α hcp phase proceeds via either homogeneous or heterogeneous nucleation depending upon temperature and zirconium content. The upper temperature limit for homogeneous to heterogeneous precipitation closely corresponds with the calculated coherent spinodal temperature. Transmission electron microscopy, x-ray analysis, and hardness changes were used to investigate the aging sequences. Precipitation begins with the formation of "modulations" on {100} planes to give two regions, one enriched and one depleted in solute. Further aging results in the formation of coherent α^1 discs on {100} planes which coarsen sufficiently to give hcp reflections in both electron diffraction and x-ray patterns. A Burgers orientation relationship between parent and produce exists $(100)\beta \parallel (0001)\alpha^1$, and $[\bar{1}11]\beta \parallel [11\bar{2}0]\alpha^1$. Results of particle size measurements indicate that growth of these α^1 discs follows a $t^{\frac{1}{3}}$ coarsening law. After long aging periods the α^1 develops into cubes with {100} interfacial planes and align along ⟨100⟩ matrix directions. The Burgers orientation relationship is retained. Cellular phase separation α_{hcp} and β_{bcc} phases, is concurrent with coarsening of coherent α^1 phase. Significant hardness increases are associated with the formation of α^1. Above the coherent spinodal, heterogeneous nucleation of equilibrium α phase occurs and this does not result in significant hardening. (auth)

5503 INFLUENCE OF INTERSTITIAL ORDERING OF NITROGEN IN TANTALUM ON ELECTRICAL RESISTIVITY. Jung, P.; Trenzinger, K. (Kernforschungsanlage, Juelich, Ger.). Acta Met.; 22: No. 1, 123-127(Jan 1974).

In tantalum samples containing more than 1.2 at. % of nitrogen in solid solution, electrical resistivity is reduced by up to 58% during annealing. It is shown that this reduction is caused by partial ordering of the nitrogen atoms in the tantalum lattice. Experimental results on the dependence of resistivity on annealing time, annealing temperature, and nitrogen concentration are discussed. (auth)

5504 2¼ CHROME–1 MOLYBDENUM STEEL IN PRESSURE VESSELS AND PIPING. Symposium held at Denver, Colorado, September 16–17, 1970. Schaefer, A. O. (Ed.). New York; American Society of Mechanical Engineers (1971). 215p. (CONF-700987-).

The publication presents eight papers that were assembled from the 21st Annual Petroleum–Mechanical Engineering Conference of ASME and the Second Annual Pressure Vessels and Piping Conference. The papers were entitled: The Strength of 2¼ Cr–1 Mo Steel at Elevated Temperatures; Notched Stress-Rupture Data for Quenched-and-Tempered 2¼ Cr–1 Mo Steel; Welding of Heavy Wall Vessels for Hydrogen Service in the Petroleum Industry; Creep-Rupture of Quenched-and-Tempered 2¼ Cr–1 Mo Steel; A Project to Obtain Low Cycle Fatigue Properties of Steels for Power Generation and Chemical–Petroleum Process Equipment; Versatility of 2¼ Cr–1 Mo as a Pressure Vessel Material; The Mechanism of Creep Embrittlement in 2¼ Cr–1 Mo Steel; and Elevated Temperature Low Cycle Fatigue Behavior of 2¼ Cr–1 Mo and 1 Cr–1 Mo–¼ V steels. (MCW)

5505 REDISTRIBUTION OF ALLOYING ELEMENTS DURING RECOVERY IN MARAGING Fe–Ni–Mo AND Fe–Ni–Co–Mo ALLOYS. Gruzin, P. L.; Rodionov, Yu. L.; Li, Yu. A.; Edneral, A. F.; Zhukov, O. P.; Perkas, M. D. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 2, 423-427(1973). (In Russian).

Resonance spectra for Fe–16 wt % Ni–5 wt % Mo and Fe–16.4 wt % Ni–5.25 wt % Mo–15.1 wt % Co were measured for low-temperature aging at 420° for 8 to 100 hrs, aging at 420° + 3 min aging at 520°, and aging at 520° for 18 min. The difference in the resonance spectra can be explained by the formation in the alloy with Co during low-temperature aging of an intermediate metastable phase and a region with short-range ordering of the Fe–Co type. (JSR)

5506 INVESTIGATION OF SHORT-RANGE ORDER IN NICKEL–MOLYBDENUM ALLOYS. Kirienko, V. I.; Potapov, L. P. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 36: No. 2, 417-420(1973). (In Russian).

Change of the short-range order in alloys with 14.4, 17.7, and 19.7 at. % Mo was studied as functions of temperature and duration of annealing in the region of existence of the metastable disorder state after abrupt quenching in water. In the 14.7 at. % alloy, small areas of ordering appeared with areas enriched in Mo, and the quantity and dimensions of the Mo slowly changes with reduction of the annealing temperature in the region of the α phase. In the 17.7 at. % alloy, the pattern was essentially the same, but an increase of the quantity of enriched Mo was observed in all the temperature range studied. In the 19.7 at. % alloy, the presence in the (001) plane of a weakly expressed circular structure was observed. The quantity of accumulated Mo atoms in the visual evaluation was greater than in the other alloys. (JSR)

5507 PHYSICAL PROPERTIES OF ω-PHASE ZIRCONIUM. Bychkov, Yu. F.; Lukhanin, Yu. N.; Mal'tsev, V. A. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved.; 36: No. 2, 413-414(1973). (In Russian).

Some physical properties of pure zirconium subjected to hydrostatic pressures of about 100 kbar at room temperature were measured. The specific heat, Young modulus, resistivity, and thermo-emf in steam with copper were determined. The values obtained were compared with those of α-Zr. Results agree well with the data obtained previously on the stability of ω-Zr. (JSR)

5508 NATURE OF HIGH-SPEED MARAGING Fe–Co–W TYPE STEELS. I. Investigation of Nature of Strengthening Phases. Gutzarts, M. I.; Susin, A. A. (Inst. of Problems of Accuracy and Durability of Machinery, Minsk). Fiz. Metal. Metalloved.; 36: No. 2, 380-387(1973). (In Russian).

Results of the study of the disperse phase of the high-speed W–Co steels with 0.06 and 0.27 wt % C were reported. It was found that in the tempered steels there are different phases according to nature: in steels with 0.06% C, there is the intermetallide of the Co_7W_6 type and in the steel with 0.27% C there is the carbide M_6C. In the process of aging of both steels, the intermetallic phase iron tungstenide appears. A conclusion is made on the effect of carbon on the phase composition of the steels studied. (tr-auth)

5509 STRUCTURAL CHANGES DURING AGING OF MARTENSITE IN IRON–NICKEL–TUNGSTEN AND IRON–NICKEL–COBALT–TUNGSTEN ALLOYS. Edneral, A. F.; Zhukov, O. P.; Perkas, M. D. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 2, 339-346(1973). (In Russian).

The structure of 17Ni–10W, 15Ni–15Co–10W, and 15Ni–20Co–10W martensitic alloys aged at 440 to 600°C, was studied by the electron-microscopic method. The types of hardening phases, the distribution and form of their segregation, and the phenomenon of the temperature recovery of the electric resistance of the 15Ni–20Co–10W alloy were investigated. (tr-auth)

5510 ABSORPTION SPECTRA OF LANTHANUM, PRASEODYMIUM, AND NEODYMIUM IN REGION OF OPTICAL FREQUENCIES. Knyazev, Yu. V.; Noskov, M. M. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 36: No. 2, 299-302(1973). (In Russian).

Optical constants of polycrystalline samples of the rare earths La, Pr, and Nd were measured by the polarization method in the region from 1.13 to 4.42 eV. It was found that the dispersion dependence of the absorption of these metals is characterized by a series of maxima, indicating the presence of an intense quantum transition in the frequency range studied. Assumptions were made on the connection of the sharp band of absorption in Pr and Nd, located at the energies of 3.05 and 4.1 eV, respectively, with quantum transition with 4f levels to the free 5d-6s band above the Fermi boundary. (tr-auth)

5511 ALLOYING ADDITIONS EFFECT ON STRUCTURAL CHANGES IN NICKEL-MOLYBDENUM COMPOSITE MATERIAL. Savchuk, A. N.; Ol'shanetskii, V. E. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 138-142(1973). (In Russian).

It was found that the intense collective recrystallization in the peripheral layer of Mo wires occurs because of the diffusion penetration of Ni. During this at the boundary of the matrix and filler, a zone of increased hardness arises, which is explained by the formation of the basic intermetallide NiMo. The diffusion of Cr into Mo is very intensely developed from the edge of the wire, the continuous intermetallide layer is not formed in this case, and the transition diffusion zone is characterized by low microhardness. Power alloy (30% Cr + 5% W + 3% Mo), introduced between foils of the matrix, with production from electrolytic Ni, promotes the active suppression of the recrystallization process in all areas of the Mo wire and sharply reduces the microhardness of the transition diffusion zone. (tr-auth)

5512 INFLUENCE OF THE METHOD OF OBTAINING Ni + ThO_2 COMPOSITION AND THE CONTENT OF THE STRENGTHENING OXIDE ON HEAT RESISTANCE. Balakin, E. I.; Zhuk, N. P.; Meerson, G. A.; Opara, B. K.; Pashkova, O. A. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 130-133(1973). (In Russian).

The method of obtaining dispersion-strengthened Ni, determining in some measure the degree of the interaction of the strengthening phase and the metallic matrix, affects the heat-resistant composition. From the viewpoint of heat resistance, the most effective is the method used to obtain disperse-strengthening materials on a Ni base in which the process of coagulation of the particles of the strengthening phase is very slowly developed. (tr-auth)

5513 STRUCTURE AND PROPERTIES OF THE ANNEALED ALLOYS OF THE Ti-Mo SYSTEM. Kolachev, B. A.; Mamonova, F. S.; Lyasotskaya, V. S.; Vedneva, L. S. (Moscow Aviation Technology Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 3, 120-124(1973). (In Russian).

Alloys of Ti with 6.8, 8.6, 11.4, and 13% Mo, have maximum stability after heating at 800, 750, 700, and 650°, respectively, with cooling air. During cooling in water of alloys of the Ti-Mo system after heating to 700 to 650°C, maximum stability characteristics are observed in the two-phase alloy Ti-11.4% Mo with very fine ($\alpha + \beta$) structure without ω phase. In alloys of the Ti-Mo system, the ω phase is not formed during cooling in air after heating to temperatures below 650° and with cooling in water after heating to temperatures below 700°C. (tr-auth)

5514 MAGNETIC RESISTIVITY OF HEAVY RARE EARTH ALLOYS. Williams, D. E. G. (Univ. of Tech., Loughborough, Eng.). J. Phys., F (London); No. 10, 1898-1902(Oct 1973).

It is shown that a simply averaged value of $(g-1)^2J(J+1)$, where g is the Landé splitting factor and J is the total angular momentum, can be used to explain the variation with composition of the magnetic disorder resistivity of Gd-Dy alloys observed by Bozorth and Suits (J..Appl. Phys., 33: 1039(1964)). (auth)

5515 AMPLITUDE-DEPENDENT INTERNAL FRICTION OF MOLYBDENUM SINGLE CRYSTALS. Sklad, P. S.; Gibals, R.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). J. Phys., F (London); 3: No. 10, 1789-1795(Oct 1973).

The amplitude-dependent internal friction of several high-purity molybdenum single crystals was examined at approximately 100 kHz over the temperature range 4.2 to 300°K. The specimens were oriented near the centre of the stereographic triangle and were deformed in tension at 156 and 450°K. Increasing the magnitude of the applied strain amplitude was found to increase the background damping in all specimens and to produce an α peak in some instances. The occurrence of the α relaxation peak was found to depend on the presence of an optimum dislocation configuration, internal stresses, and applied strain amplitude. The optimum dislocation configuration appears to be one of edge-type segments present after small amounts of deformation and under the influence of locally high internal stresses. Other segments apparently achieve this or other optimum configurations after much larger amounts of plastic deformation when the overall internal stress level is higher. Results are interpreted in terms of the depinning of kinks trapped by point defects as the likely mechanism of the α peak. (auth)

5516 ORIENTATION OF GRAIN BOUNDARIES IN CADMIUM RECRYSTALLIZED DURING HOT DEFORMATION. Sastry, D. H. (Inst. of Science, Bangalore, India); Prasad, Y. V. R. K.; Vasu, K. I.; Rao, P. R. J. Mater. Sci.; 8: No. 10, 1517-1519(Oct 1973).

A feature of grain-boundary migration during high-temperature fatigue is the metallographic observation on plane surfaces of the so-called diamond or orthogonal configuration of grain boundaries occurring as a result of their migration to stable positions at ~45° to the stress axis. In the studies reported here, creep and hot fatigue were performed on cadmium. An indirect indication of the importance of grain-boundary sliding in causing the observed changes in grain-boundary alignments was obtained by experiments in which recrystallization in cadmium was induced (a) under purely thermal conditions, (b) during hot-working, (c) during creep, and (d) during hot fatigue, followed by measurements of angular distribution of grain boundaries associated with the newly formed grains. (UK)

5517 Y HYPERFINE FIELDS IN YFe_2, YFe_3, AND Y_2Fe_{17}. Oppelt, A.; Buschow, K. H. J. (Technische Univ., Darmstadt, Ger.). J. Phys., F (London); 3: No. 10, L212-L215(Oct 1973).

NMR spin echo spectra of ^{89}Y were studied at 4.2°K for YFe_2, YFe_3, and Y_2Fe_{17}. The sign and magnitude of the hyperfine field at the Y sites was determined and interpreted in terms of long-range conduction electron spin polarization. (auth)

5518 THERMAL CONDUCTIVITY OF NIOBIUM-ZIRCONIUM ALLOYS AT LOW TEMPERATURES. Morton, N.; James, B. W.; Wostenholm, G. H.; Sanderson, R. J.; Black, M. A. (Univ. of Salford, Eng.). Cryogenics; 13: No. 11, 665-670(Nov 1973).

The thermal conductivities of three samples of heat-treated niobium-zirconium alloy were measured at low temperatures and analyzed into components due to phonon and electron carriers. The phonon carrier component is found to be dominant at most temperatures, particularly below the superconducting critical temperature. The observed variations in the magnitude of the conductivity are correlated with the metallurgical structures. (auth)

5519 STABILITY OF THE DAMAGE STATE IN NEUTRON-IRRADIATED MOLYBDENUM. Sikka, V. K.; Moteff, J. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 17: 142-143(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5520 EFFECT OF HIGH HELIUM CONTENT ON STAINLESS-STEEL SWELLING. Wiffen, F. W.; Bloom, E. E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 143-144 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5521 EFFECT OF HELIUM ON FATIGUE BEHAVIOR OF THE MOLYBDENUM-BASE-ALLOY TZM. Michel, D. J.; Serpan, C. Z. Jr.; Smith, H. H.; Pieper, A. G. (Naval Research Lab., Washington, DC). Trans. Amer. Nucl. Soc.; 17: 144-145(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5522 VIEW OF GAMMA-PHASE AND DILUTE-URANIUM ALLOY DEVELOPMENT. Bauer, A. A. (Battelle Columbus Labs., OH). Trans. Amer. Nucl. Soc.; 17: 157-158(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5523 DISPERSION-STRENGTHENED FERRITIC STEELS FOR FAST REACTOR STRUCTURAL MATERIALS. Huet, J. J. (CEN-SCK, Mol, Belgium); Van Asbroeck, P.; Leroy, V. Trans. Amer. Nucl. Soc.; 17: 200(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5524 EFFECT OF CARBON ON THE CREEP-RUPTURE PROPERTIES OF 2¼ Cr–1 Mo STEEL. Klueh, R. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 200-201 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5525 HETEROGENEITY OF PROPERTIES AND MICROSTRUCTURE IN A THICK STAINLESS-STEEL WELDMENT. King, R. T.; Goodwin, G. M.; Stiegler, J. O. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 201-202(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5526 ELEVATED-TEMPERATURE PROPERTIES OF SHIELDED METAL ARC TYPE 308 STAINLESS-STEEL WELD METALS WITH VARYING FERRITE CONTENTS. King, R. T.; Berggren, R. G.; Cole, N. C.; Goodwin, G. M.; Slaughter, G. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 202-203(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5527 CURRENT AND ADVANCED PRESSURE VESSEL SURVEILLANCE SPECIMEN EVALUATION TECHNIQUES. Perrin, J. S.; Sheckherd, J. W. (Battelle Columbus Labs., OH). Trans. Amer. Nucl. Soc.; 17: 513-514(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiation Effects

Refer also to abstracts 5689, 6729, and 6730.

5528 (CEA-CONF-2334) DECHANNELIZATION AT LOW TEMPERATURES BY IRRADIATION DEFECTS IN IRON. Jousset, J. C.; Lorenzelli, N. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 12p. (In French). (CONF-730574-4). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

Dechanneling effects produced by defects created in iron by ^{235}U fission products were studied. An iron sample is sandwiched between two sources consisting of four deposits of enriched ^{235}U having unequal thickness. Low-temperature anneals were carried out after the samples were irradiated at 20°K with neutrons. In the case of the channeling patterns obtained, the contrast existing between the irradiated and the nonirradiated zones of the sample disappeared progressively during annealing. There were no visible contrast differences in the channeling patterns obtained after an annealing at a maximum temperature (485°K). The curve representing the variation in dechanneling as a function of the fluence of the fission fragments exhibits a damage-saturation effect. The dechanneling effects disappear during annealing in three stages (110°K, 130 to 220°K, and 280 to 400°K). The self-interstitials undergo the most significant dechanneling when in cluster form. Carbon interstitials have dechanneling cross sections similar to that of hydrogen in palladium. (FR)

5529 (CEA-CONF-2335) STUDY OF IRRADIATION CAVITIES IN ALUMINUM BY SMALL-ANGLE SCATTERING. Use of a Kratky Chamber. Baron, J. L.; Cadalbert, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 27 Apr 1973. 11p. (In French). (CONF-730571-1; SMG-73/1677). Dep. NTIS (U. S. Sales Only) $3.00

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

Cavities produced in metals by irradiation constitute x-ray scattering centers; the analysis of small-angle scattering curves enables the number and certain characteristics of such centers to be determined. High-purity aluminum samples irradiated with fast neutrons were used in the experiments. A Kratky chamber was used under various different experimental conditions to determine the angular distribution of the intensity scattered around the primary x-ray beam. The geometrical parameters defining the cavities are compared with those obtained by other methods, in particular electron microscopy. (FR)

5530 (CEA-CONF-2354) SIMULATION BY BOMBARDMENT WITH Ni^{+} IONS OF MEDIUM ENERGY OF THE EFFECTS OF IRRADIATION PRODUCED IN A REACTOR IN NICKEL AND IN AUSTENITIC STEELS. Delaplace, J.; Azam, N.; Le Naour, L.; Lott, M.; Fiche, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 24 May 1973. 31p. (In French). (CONF-730574-2; SMG-73/1687). Dep. NTIS (U. S. Sales Only) $3.75.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

Heavy-ion bombardment can be used to produce in a short time (hours) many atomic displacements that normally require more than a year of reactor irradiation. However, this technique has some objectionable features: low range, nonuniform production of defects with depth, and impurity-atom injection into specimen. Formation of voids by vacancies clustering was studied in pure nickel by 500-keV nickel ion bombardment. Void swelling increases with irradiation temperature up to a maximum about 620°C, then decreases. Helium pre-injection into nickel increases void density but reduces swelling. Swelling increases linearly with dose. Void size and void density increase quickly during the outset of irradiation. The evolution of dislocation network induced by nickel ion bombardment in stainless steel was studied. A high dislocation density was observed between 400 and 700°C. There is no significant variation of dislocation density with the starting microstructure of material (solution treated or cold worked) and with dose when dose runs above 10 dpa. Dislocation density increases with dose rate and decreases with increasing temperature. (auth)

5531 (CEA-CONF-2355) DOSIMETRY AND RADIOINDUCED DAMAGE. Genthon, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 11p. (In French). (CONF-730573-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of the Euratom working group on irradiation devices; Saclay, France (24 May 1973).

The dosimetry group of Euratom studies problems associated with radiation-induced damage. The first report concerns the definitions of fission flux and fast flux and devotes a large part to the dosimetry of graphite irradiation: model adopted, parameters employed to describe fluences, magnitudes, measurements, and measurement techniques. The second report concerns the dosimetry in relation to the electronic properties and the swelling of metals: model adopted, parameters employed and magnitudes. (FR)

5532 (CEA-CONF-2439) INFLUENCE OF INSTANTANEOUS FLUX ON THE FORMATION OF DEFECTS IN NICKEL IRRADIATED WITH FAST NEUTRONS AT 250°C. Silvent, A.; Regnard, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 14 May 1973. 20p. (In French). (CONF-730669-1). Dep. NTIS (U. S. Sales Only) $3.00.

From metallurgy colloquium: the phenomena of precipitation and their consequences on the properties of metallic alloys; Saclay, France (25 Jun 1973).

The irradiation of pure Ni at 250°C (1.5×10^{14}n/cm^2/sec and 2.7×10^{13}n/cm^2/sec) leads to the formation of either an ordered network of loops or to cavities. An interpretation of the results is given. (FR)

5533 (CEA-CONF-2442) HARDENING AFTER COLD-HAMMERING AND SOFTENING IN COPPER AFTER VERY WEAK IRRADIATION AT 20°K BY NEUTRONS. von Stebut, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 44p. (In French). (CONF-730806-4). Dep. NTIS (U. S. Sales Only) $4.25.

From third international conference on the strength of metals and alloys; Cambridge, UK (20 Aug 1973).

5534 (CONF-730726-3) PROPERTIES OF REINFORCED FERRITIC STEELS IN VIEW OF THEIR APPLICATION AS CANNINGS FOR FAST REACTOR FUELS. Huet, J. J.; Casteels, F.; De Wilde, L.; Leroy, V.; Snykers, M.; Van Asbroeck, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Centre de Recherches Metallurgiques, Liege (Belgium)). 1973. 14p. (SM-173/2). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Work performed under United States–Euratom Fast Reactor Exchange Program.

Ferritic steels which are reinforced by dispersion and have a nominal composition of Fe–13% Cr–1.5% Mo–3.5% Ti–2% TiO_2 are able to resist the strain incurred in fast reactor fuel cans, and resistance to corrosion in sodium is excellent. Radiation embrittlement of these ferritic steels at 700°C is slight, and the total stretch which they retain (10 to 15%) is sufficient to accommodate distortions. Simulation tests have shown that

the ferritic alloys are highly resistant to swelling caused by energy particle irradiation. (6 figures) (DLC)

5535 (COO-1198-1012) POINT DEFECTS IN METALS. Koehler, J. S. (Illinois Univ., Urbana (USA)). 1973. Contract AT(11-1)-1198. 11p. Dep. NTIS $3.00.

A review is presented of the knowledge of point defects in pure metals. Data are tabulated for vacancies and divacancies in fcc metals, and for defects in bcc metals. Production of Frenkel defects by irradiation is also discussed; data are tabulated for both fcc and bcc metals. Questions that need answering are posed. (16 references). (DLC)

5536 (EUR-5035) RECOMMENDATION ON THE MEASUREMENT OF RADIATION-INDUCED DAMAGES IN REACTOR STRUCTURAL MATERIAL. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Oct 1973. 10p. (In French). Dep. NTIS (U. S. Sales Only) $3.00. EUR FB 25,-.

Recommendations are presented for irradiation measurements on metals and especially that of steel. This publication follows the report EUR-4867f, already published, which treated essentially graphite irradiations. (auth)

5537 (GULF-GA-B-12323) CONSTRUCTION REPORT: GA17-7 (P13N) IRRADIATION CAPSULE. Steibel, J. S.; Czech, B. A. (Gulf General Atomic Co., San Diego, Calif. (USA)). 4 Oct 1972. Contract AT(04-3)-167. 24p. Dep. NTIS $3.25.

A detailed description of the GA17-7 (P13N) capsule is presented, including fuel sample weights and dimensions, dimensions of capsule components, and piggyback (secondary) experiment locations. The report is intended as a guide for operational thermal analysis, as a reference for post-irradiation examination, and as a reference for future capsule design. (auth)

5538 (HEDL-TME-73-67) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May-July 1973. Claudson, T. T. (Comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 227p. AT.

Results of research on radiation damage and other effects in reactor materials are summarized. Most of the effort during the period was devoted to steel, stainless steel, and refractory alloys and metals. The research was conducted by Atomics International, Aerojet Nuclear Company, Argonne National Laboratory, Hanford Engineering Development Laboratory, Naval Research Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratory, and University of Cincinnati. (JRD)

5539 (N-72-27717) EVALUATION OF INSULATION MATERIALS AND COMPOSITES FOR USE IN A NUCLEAR RADIATION ENVIRONMENT, PHASE 1. Greenhow, W. A.; Lewis, J. H. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). May 1972. 321p. (NASA-CR-2045; FZK-378). NTIS.

This study was carried out to evaluate flight-qualified Saturn 5 materials, components, and systems for use, with or without modification, in the radiation environment of the nuclear-flight system. The results reported are primarily intended to aid designers in their evaluation and selection of off-the-shelf equipment which may meet the stringent requirements and specifications associated with application on a reusable nuclear powered space system, i.e., the reusable nuclear shuttle (RNS). One of the factors that must be evaluated in the design of the RNS is the effects of radiation on materials; and it is toward this aspect of the overall effort that this analysis has been directed. (STAR)

5540 (N-72-27718) EVALUATION OF INSULATION MATERIALS AND COMPOSITES FOR USE IN A NUCLEAR RADIATION ENVIRONMENT, PHASE 2. Final Report. Westerheide, D. E.; Carter, H. G.; Erickson, R. C.; Kerlin, E. E. (General Dynamics Corp., Fort Worth, Tex, (USA). Convair Aerospace Div.). May 1972. 206p. (NASA-CR-2042; FZK-380). NTIS.

The nuclear heating of the propellant in all of the four baseline reusable nuclear shuttle (RNS) configurations studied was much lower than that of the nuclear flight module configuration with the 5000-MW NERVA analyzed previously. Although the nuclear heating has been reduced, the effect of nuclear heating on the propellant as well as the effect of nuclear heating on internal structures such as antivortex baffles, screens, and sump components cannot be neglected. In addition, it was found that the present analytical procedures were not able to predict boundary layer initiation and breakoff points with the accuracy necessary to predict propellant thermodynamic nonequilibrium (stratification) and/or mixing. (STAR)

5541 (NP-19852, pp 122-124) POINT DEFECTS IN IRRADIATED COPPER AND Cu_3Au. Sakairi, H.; Yagi, E.; Koyama, A.; Karasawa, T.; Hasiguti, R. R. Dec 1972.

5542 (SLA-73-5835) DEPTH DISTRIBUTION AND MIGRATION OF IMPLANTED HELIUM IN METAL FOILS USING PROTON BACKSCATTERING. Blewer, R. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 28p. (CONF-731028-4). Dep. NTIS $3.50.

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973).

Proton backscattering at 2.5 MeV was used to measure the mean depth and profile of implanted helium distributions as a function of implant energy, implant fluence, and post-implant anneal temperature in copper foils of varying thickness. Distributions implanted at 50, 100, and 150 keV agree with calculated ranges for helium in copper. At room temperature the shape of the distributions is Gaussian with no evidence of a supertail or of the peaks being skewed either toward the surface or the interior of the foils. Implantation of some foils was performed at two energies (highest energy first) using both equal and unequal doses. Resultant profiles were those expected from overlapping Gaussians centered at the predicted depths. Implanted helium fluences ranging from 5×10^{16} to 3×10^{17} He^+/cm^2 result in backscattering peaks for helium which increase in magnitude in the proper proportion to increasing fluence. Effect of in situ isochronal and isothermal annealing on the disposition of the implanted helium was also observed. Above 200°C, the peak of the helium distribution decreases in magnitude, but no lateral spreading of the profile (as expected in Fick's Law diffusion) is observed. Moreover, the helium peak height decreases steadily for each of the isochronal temperature plateaus between 200 and 450°C. Isothermal annealing at 225 and 400°C produces almost no additional change in the magnitude of the helium peak over three anneal periods of increasing duration. Throughout annealing, the symmetric form of the Gaussian distribution is retained. There is no evidence of preferential diffusion of the implanted helium either into the undamaged depths of the foils or through the residual ion-implantation-induced damage between the helium-implanted layer and the foil surface. These observations could be explained if the helium were trapped at or near its end-of-range location at room temperature and then released in proportionate fractions at progressively higher temperatures by formation and subsequent rupture of bubbles developing in the implanted layer. Evidence was obtained by scanning electron microscopy which supports this hypothesis. Simultaneous profiling of oxygen and carbon in the foils or on their surfaces is also described. (8 figures, 23 references) (auth)

5543 (WAPD-TM-1094) POST-IRRADIATION RECOVERY OF IRRADIATION DAMAGE (LWBR DEVELOPMENT PROGRAM). Dollins, C. C. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Aug 1973. Contract AT(36-1)-GEN-14. 33p. Dep. NTIS $3.75.

During irradiation of metals, fast neutrons produce regions depleted of atoms. It is believed that these regions are responsible for most of the hardening observed after neutron irradiation. Discussions are presented on dissolution of the depleted zones in metals during post-irradiation annealing and subsequent recovery of the yield strength. The zones dissolve by emitting vacancies and, therefore, have an activation energy made up of the sum of the vacancy binding energy to the zone and the vacancy migration energy. The resultant activation energy increases with recovery. For zirconium-base alloys it was found that the activation energy varies from 49,700 cal/mole at 10% recovery to 61,600 cal/mole at 50% recovery. Experimental data available indicate a similar increase in the activation energy with recovery. (auth)

5544 DECHANNELING FROM 2-MeV-He^+ DAMAGE IN GOLD. Merkle, K.L.; Pronko, P.P.; Gemmell, D.S.; Mikkelson, R.C.; Wrobel, J.R. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 8: No. 3, 1002-1010 (1 Aug 1973).

The dechanneling of 2-MeV He^+ incident in the [001] direction of monocrystalline gold films has been investigated by means of the backscattering technique. The aligned spectra of the undamaged crystal indicate good agreement with channeling theories regarding the surface dechanneling and the dechanneling as a function of depth. Damage was introduced by 2-MeV He^+ incident in a random direction and the resultant increase of the dechanneling rate was studied as a function of damage dose. It is found that the dechanneling is mainly due to defect clusters produced in energetic displacement cascades. A dechanneling cross section of $\sigma_d = 2.3 \times 10^{-14}$ cm^2 is derived under the assumption that all of the dechanneling is due to the clusters visible by transmission electron microscopy (TEM). The dechanneling cross section is about a factor of 5 smaller than the geometrical cross section of the clusters as determined by TEM. Deviations from linearity in the dechanneling-rate-versus-dose cure are noticeable at 5×10^{15} He^+/cm^2. An analysis of the saturation behavior gave a value of $r_0 = 89$ Å for the average radius of a displacement cascade. (auth)

5545 CHANNELING EFFECTS IN THE SCATTERING OF 30-keV ELECTRONS IN THIN COPPER CRYSTALS. Korobochko, Y.S.; Berezovskii, E.L.; Grachev, B.D.; Kozlovskii, S.S.; Mineev, V.I.

(M. I. Kalinin Leningrad Polytechnical Institute). Sov. Phys.-Solid State 14: No. 11, 2812-2814 (May 1973).

A study was made of the angular distribution of 50-keV electrons scattered in a copper single-crystal film 340±15 Å thick in the scattering-angle range 0–165°. Measurements were carried out for two orientations of the film with respect to the electron beam, corresponding to anomalous transparency and anomalous electron absorption in the film. The ratio of the scattering intensities in the two orientations displays several features which can be explained qualitatively on the basis of a change in the effective film thickness. (auth)

5546 DEFECT DRAGGING CONTRIBUTION TO DISLOCATION DAMPING IN ELECTRON-IRRADIATED HIGH-PURITY POLYCRYSTALLINE ALUMINUM. Seiffert, S. L.; Simpson, H. M.; Sosin, A. (Univ. of Utah, Salt Lake City). J. Appl. Phys.; 44: No. 8, 3404-3410(Aug 1973).

A study by internal friction and Young's modulus measurements were made on high-purity polycrystalline aluminum of the effects on dislocation damping by 1-MeV electron irradiation in the temperature range 78 to 360°K. These measurements confirm the presence of an internal friction "peaking" effect in aluminum, in agreement with the defect-dragging model proposed by Simpson and Sosin. In particular it is observed that, during electron irradiation and for specific mechanical and thermal histories of the sample, the logarithmic decrement δ increases and later decreases. The increase is found to be generally strain-amplitude independent and to be highly structure-dependent, disappearing after a suitable high-temperature anneal. Simultaneous modulus measurements show little or no effect due to electron irradiation between 78 and 240°K, but the modulus increases monotonically for irradiations above 240°K. The corresponding point-defect kinetics exhibit a complex annealing behavior. (auth)

5547 GROWTH OF TOPOGRAPHY DURING SPUTTERING OF AMORPHOUS SOLIDS. IV. A Generalized Theory. Carter, G.; Colligon, J. S.; Nobes, M. J. (Univ. of Salford, Eng.). J. Mater. Sci.; 8: No. 10, 1473-1481(Oct 1973).

Theories of topographic surface development during ion bombardment fall broadly into two categories, one based upon erosion of intersecting planes and the other on a point-by-point erosion basis. A recent paper by Barber et al (J. Mater. Sci.; 8: 1030 (1973)) has shown how, in semiquantitative fashion, an earlier theory by Frank ("Growth and Perfection of Crystals" (Wiley, New York, 1958) p.411) on chemical dissolution or growth of crystals, can be developed to encompass the ion sputtering case. This theory itself is based upon the kinematic wave equation outlined by Lighthill and Whitham (Proc. Roy. Soc.; 229A: 281 (1955) and 229A: 317 (1955)) and applies to problems of river flooding and traffic flow. In this communication, the earlier topographic development theories are shown to fit precisely and analytically into the Frank development of the kinematic wave treatment, and it is also shown how the occurrence of sharp-angled cones formed on surfaces can be analytically and unequivocally predicted. (auth)

5548 CURRENT AND ADVANCED PRESSURE VESSEL SURVEILLANCE SPECIMEN EVALUATION TECHNIQUES. Perrin, J. S.; Skeckherd, J. W. (Battelle Memorial Inst., Columbus, Ohio). Conf. Remote Syst. Technol., Proc.; No. 21, 86-90(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

Nuclear reactor pressure vessels are exposed to irradiation during normal operation. The mechanical properties of the steels typically used are appreciably changed by the irradiation. Commercial power reactors incorporate surveillance capsules containing mechanical property specimens including tensile specimens. Charpy V-notch impact specimens, and, in some capsules, wedge-open-loading fracture mechanics specimens. Capsules are periodically removed, and specimens are tested to determine the changes in the mechanical properties. Current testing techniques include conventional Charpy V-notch impact testing, tensile testing, and fracture toughness testing. Advanced testing techniques which show promise for surveillance testing include instrumental Charpy testing and acoustic emission monitoring. (auth)

5549 STABILITY OF MULTIFILAMENTARY SUPERCONDUCTING MAGNET MATERIALS TO NEUTRON IRRADIATION. Parkin, D. M.; Schweitzer, D. G. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 147(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5550 TRITIUM RELEASE FROM NIOBIUM. Pennington, C. W.; Verghese, K.; Elleman, T. S. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 17: 151-152(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5551 DIFFUSION OF FISSION PRODUCTS IN ALPHA-THORIUM. Fox, C. H. Jr. (Atomic Energy Commission, Oak Ridge, TN); Craft, C. M.; Zumwalt, L. R. Trans. Amer. Nucl. Soc.; 17: 177-178(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5552 CORRELATION OF CLADDING CHEMICAL ATTACK IN MIXED OXIDE FUEL RODS. McCarthy, W. H.; Craig, C. N. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 17: 193(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5553 EFFECT OF HEAT TREATMENT ON FAST-NEUTRON DAMAGE IN TYPE 316 STAINLESS STEEL. Bloom, E. E.; Leitnaker, J. M.; Stiegler, J. O. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 203-204(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5554 EFFECT OF STRESS ON SWELLING. Wazzan, A. R. (Electricite de France, Clamart). Trans. Amer. Nucl. Soc.; 17: 204-206(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5555 DEFECT PRODUCTION IN NEUTRON AND CHARGED-PARTICLE IRRADIATIONS. Doran, D. G. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 207-208 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5556 ANALYTICAL INVESTIGATION OF VOID NUCLEATION AND GROWTH IN METALS. Prasad, K. C. (Catholic Univ. of America, Washington, DC); Murley, T. E. Trans. Amer. Nucl. Soc.; 17: 208-209(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5557 IN-REACTOR CREEP OF STAINLESS-STEEL TUBES Walters, L. C.; Walter, C. M. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 209-210(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5558 PHENOMENOLOGICAL STUDY OF THE TIME-TO-RUPTURE IN POSTIRRADIATION AND IN-PILE CREEP FOR 20% CW TYPE 316 STAINLESS STEEL. Vaidyanathan, S.; Sim, R. G. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 211-212(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5559 SOLUTE REDISTRIBUTION IN ION-BOMBARDED VANADIUM. Santhanam, A. T.; Okamoto, P. R.; Taylor, A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 214-215(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5560 UNIRRADIATED UO_2 IN IRRADIATED ZIRCONIUM ALLOY CLADDING. MacDonald, R. D.; Hardy, D. G.; Hunt, C. E. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 17: 216-217(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Other Materials

Refer also to abstracts 4900, 5442, 5444, 5445, 5464, 5493, 5539, 5540, 6739, 7345, 7398, 7407, 7454, and 7455.

5561 (CEA-CONF-2372) NUMERICAL CALCULATIONS OF IMPURITY PROFILES AND OF ENERGY DEPOSITED BY IMPLANTATION OF IONS OF MEDIUM ENERGY. Comparison With Experiment. Combasson, J. L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 27 Jun 1973. 26p. (In French). (CONF-730574-1). Dep. NTIS (U. S. Sales Only) $3.50.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The paths of heavy ions slowing down in an amorphous material were studied together with the spatial distribution of the damage caused by an incident ion and the associated collision cascade during an ion-implanting process. The Winterbon model was adopted. Results are in good agreement with experimentally measured values. (12 figures) (auth)

5562 (CONF-731101-28) THERMAL AND ELECTRICAL CONDUCTIVITIES AND SEEBECK COEFFICIENTS OF UNIRRADIATED AND IRRADIATED GRAPHITES FROM 300 TO 1000 K. Moore, J. P.; Graves, R. S.; McElroy, D. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 22p. Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The thermal conductivity, λ, electrical resistivity, ρ, and absolute Seebeck coefficient, S, of two grades of nearly isotropic graphite were neasured from 300 to 1000 K both before and after neutron irradiation up to 5.0×10^{21} n/cm^2 (>50 KeV). Nominal irradiation temperatures were 823, 923, and 1023 K. The thermal resistance, λ^{-1}, of the unirradiated graphites was proportional to T from 500 to 1000 K. Neutron irradiation decreased λ at 300 K by a factor of 4.5 and increased ρ at 300 K by 2.5, in general agreement with previous investigations, and irradiation changed S from small negative values to large positive ones. The product of thermal conductivity and electrical resistivity was nearly constant with fluence from 2.6×10^{21} to 5.0×10^{21} n/cm^2. (auth)

5563 (COO-1105-203) ELECTRON SPIN RESONANCE STUDY OF TRANSPORT DYNAMICS OF THE SELF-TRAPPED HOLE IN CALCIUM FLUORIDE. Fuller, G. E.; Moran, P. R. (Wisconsin Univ., Madison (USA)). 1973. Contract AT(11-1)-1105. 165p. Dep. NTIS $10.25.

Thesis. Submitted by G. E. Fuller.

A study was made of the formation, annealing, and spin–lattice relaxation of self-trapped holes in CaF_2 single crystals. Production of self-trapped holes in CaF_2 subjected to 120-kVp x rays is discussed. A simple saturating exponential x-ray exposure dependence is observed with an initial production rate of approximately one self-trapped hole produced per 40 eV of absorbed photon energy and a saturated concentration of about 2.5×10^{16} holes/cm^3. The production behavior observed by ESR is compared to thermoluminescent (TL) and thermally activated current (TAC) studies, showing that the production supralinearity observed in TL studies is due to the recombination mechanism rather than the production mechanism. Isothermal annealing of the self-trapped hole was carried out at 110 to 140°K. A two-component decay was found with each component obeying linear kinetics. A two-step coupled decay model for the two-component behavior is discussed, and correlations between the ESR isothermal annealing results and the TL and TAC studies are described. Analysis of the temperature dependence of the isothermal annealing rate shows that the self-trapped hole annealing behavior is well described by the theory of small polarons. At temperatures near 140°K, the decay rates behave approximately as simple thermally activated functions with activation energies of 0.325 eV for the slower decay component and 0.30 eV for the faster decay component. The spin–lattice relaxation rate of the self-trapped holes was studied from 78 to 140°K. A well-behaved temperature dependence was observed showing no correlation with the annealing kinetics. The relaxation rate can be fitted either to a simple thermal activation function or to a power law function of the temperature. (19 figures, 63 references) (auth)

5564 (EUR-4920) ESR STUDY OF IRRADIATED PLASTICS. Onderdelinden, D.; Strackee, L. (Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands)). Apr 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25. EUR B.Fr. 40.-.

In connection with a study on the detection of irradiated foodstuffs by means of ESR, the induction of free radicals in plastic packaging material by ionizing radiation was investigated at doses of 2 Mrad. Except for polymers with a large fraction in the glass state above the glass temperature and polymers with plasticizers, radicals can be measured during periods up to a few months. Radicals yield was found to depend on dose rate and temperature. A theoretical model that accounts for these parameters is discussed. Decay was found to follow approximately first order kinetics characterized by two rate constants. (EU)

5565 MULTIPHONON RELAXATION OF EXCITED STATES OF RARE-EARTH IONS IN YVO_4, $YAsO_4$, AND YPO_4. Reed, E.D. Jr.; Moos, H.W. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. B 8: No. 3, 980-987 (1 Aug 1973).

The multiphonon relaxation process has been studied in the host crystals YVO_4, $YAsO_4$, and YPO_4 using the rare earths Ho^{3+}, Er^{3+}, Eu^{3+}, and Pr^{3+} as probes. Lifetimes were measured with the phase-shift technique using a high-frequency (60-kHz maximum) mechanical light chopper of new design. Measurements were made of the multiphonon relaxation rate at 4.2 °K on many of the rare-earth J manifolds, and of the temperature dependence of the rate for selected manifolds. Vibronic sidebands were recorded for YVO_4 and $YAsO_4$. Both the 4.2 °K multiphonon decay rate as a function of energy gap to the next lower manifold and the temperature dependences of these rates indicate that individual peaks in the phonon energy distribution (as determined from the vibronics) play a strong role in the decay, in contrast to previous results. (auth)

5566 NONTHERMALIZATION AND LARGE VARIATION IN MULTIPHONON RELAXATION RATE AMONG RARE-EARTH-ION STARK LEVELS. Reed, E.D. Jr.; Warren Moos, H. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. B 8: No. 3, 988-992 (1 Aug 1973).

In $^5D_1$ of YVO_4:Eu^{3+} at 2.0 °K, multiphonon relaxation occurs from the Stark level because it is not in thermal equilibrium with the lower of the two levels in the manifold. The energy levels of $^5D_1$ were simple enough to allow the construction of a detailed mathematical model which provided an excellent fit to the temperature-dependent multiphonon relaxation rate. The two Stark levels of $^5D_1$ also differ in multiphonon relaxation rate by factor of about 15. The Eu $^5D_1$ fluorescence was too weak in $YAsO_4$ and YPO_4 for these systems to be investigated for these effects. Similar effects appear also with Ho^{3+} E($^5S_2$, $^5F_4$) in YVO_4 and $YAsO_4$. (auth)

5567 CHANNELING OF 1-MeV He^+ IONS IN NaCl: DAMAGE AND TEMPERATURE EFFECTS. Hollis, M.J. (Solid State Science Branch, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada). Phys. Rev. B 8: No. 3, 931-935 (1 Aug 1973).

Channeling of 1-MeV He^+ ions in NaCl has been studied over the temperature range 77–870 K. The rate of damage by the He^+ ions at 77 and 300 K was measured. A previously unobserved reduction in χ_{min} occurred at ion doses $>5\times10^{15}$ ions/cm^2. Measured χ_{min} (<100>) values for undamaged NaCl were 2% at 77 K rising to 10% at 870 K. These are the first quantitative χ_{min} data for He^+ ion channeling in NaCl. (auth)

5568 KINETICS OF MOTION OF SLIP BANDS IN NaCl CRYSTALS. Zaitsev, S.I.; Nadgornyi, E.M. (Institute of Solid State Physics, Academy of Sciences of the USSR, Chernogolovka). Sov. Phys.–Solid State 14: No. 11, 2787-2790 (May 1973).

The range of leading dislocations in boundary slip bands was experimentally studied as functions of time and internal stress in pure NaCl crystals and in NaCl crystals irradiated with gamma rays. It was shown that leading dislocations are retarded in their motion. The time dependence of the changing range is not linear, but has the form $l_1 \simeq t^\beta$ (with $\beta \simeq 0.2$) and is the same in pure and in irradiated crystals within three orders of magnitude of load-application time. The conclusion is that the authors' previous model of a two-sided slip band is in qualitative agreement with the experimental results. (auth)

5569 DETERMINATION OF THE LOCATION OF INTERSTITIAL SODIUM ATOMS IN A SILICON LATTICE. Skakun, N.A.; Dikii, N.P.; Matyash, P.P.; Korol', V.M. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 1, 123-125 (July 1973).

Channeling of charged particles was used to determine the location of interstitial sodium atoms in a silicon lattice. The resonance of the reaction Na^{23} $(p,\alpha_0)Ne^{20}$ was used at an energy of 1083 keV. A silicon crystal alloyed with sodium at room temperature with a dose of 6.10^{15} cm^{-2} and an energy of 50 keV was bombarded by protons (E_p = 1095 keV). The specimen was annealed in vacuum at 400°C. The authors measured the alpha-particle yields from a single crystal oriented relative to the beam along the [110] and [111] crystallographic axes and in the direction where channeling is absent. The relative α-particle yields were 1.04, 0.58, and 1.00, respectively. Analysis of elastic backscattering of 940-keV α particles channeled along the [110] axis made it possible to evaluate the thickness of the disordered surface layer. In our case it was approximately 950 Å. (auth)

5570 ORIENTATION EFFECTS OF β-PARTICLE SCATTERING IN LARGE-THICKNESS SINGLE CRYSTALS. Vorob'ev, A.A.; Bobudaev, A.Y.; Vorob'ev, S.A.; Kaplin, V.V. Sov. Phys.-Solid State 14: No. 11, 2808-2811 (May 1973).

We investigate the influence of the orientation of single crystals of the NaCl type on the penetration and back-scattering of electrons from a $(Sr-Y)^{90}$ β-particle source. The yield of the orientationally scattered electrons is attributed, within the framework of classical mechanics concepts, to focusing of the electrons by chains of nuclei. The observed anomalous penetration of the electrons is attributed to their capture by stable trajectories of motion. A study of the orientational electron-scattering effects in thick single crystals has shown that the yield of the back scattering is more sensitive to the influence of the crystal structure than small-angle scattering. (auth)

5571 INFLUENCE OF OXYGEN AND NATURE OF IRRADIATION ON THE IMPURITY LUMINESCENCE SPECTRA OF SILICON. Mudryi, A. V.; Yukhnevich, A. V. (V. I. Lenin Belorussian State University, Minsk). Sov. Phys. Semicond. (Engl. Transl.); No. 1, 117-118(Jul 1973).

Data on the luminescence of irradiated silica as affected by annealing, oxygen content, and type of radiation are presented. These data were recorded at ≥6°K using a spectrometer having a resolution of 5×10^{-4} eV. Results are tabulated which indicate that annealing of the structure defects generated by fast neutrons produces luminescence centers which are not found in significant concentration in crystals subjected to electron bombardment or gamma radiation. It is noted that the effects of electrons and gamma radiation are very similar. (JRD)

5572 REDISTRIBUTION OF BORON IN SILICON AS A RESULT OF IRRADIATION WITH FAST ELECTRONS. Seryapin, V. G.; Seryapina, N. V.; Smirnov, L. S.; Romanov, S. I.; Obodnikov, V. I. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.-Semicond. (Engl. Transl.); 7: No. 1, 128-129(Jul 1973).

Changes in radioinduced diffusion of B in Si bombarded with 3.2-MeV electrons at 20°C were observed. The distribution of B was determined from diffusion-zone electric conductivity measurements. Results show that fast electron irradiation causes direct migration of B in Si. It was also found that B diffuses in the direction of the electron beam and that the shift of the P–n function decreases with decreasing function depth. (JRD)

5573 CHANGES IN THE ENERGY-LEVEL STRUCTURE OF LITHIUM-DOPED GERMANIUM DUE TO IRRADIATION WITH 10^{19} γ Ryas/cm² AND ANNEALING. Sinishchuk, P.K.; Abiev, A.K. (Radiation Research Section, Presidium of the Academy of Sciences of the Azerbaidzhan SSR, Baku). Sov. Phys.-Semicond. 7: No. 1, 148-149 (July 1973).

The mechanisms of formation and changes in radioinduced defect levels in lithium-doped germanium during isochronous annealing were investigated. Results show the temperature dependencies of the Hall coefficient in samples exposed to gamma dose rates of 10^{19}/cm². Energy level spectra of defects are represented by diagrams. It is noted that if the lithium concentration is appropriate, an increase of total dose changes the energy levels during irradiation. (JRD)

5574 ROLE OF COLLECTIVE PROCESSES IN THE FORMATION OF PRIMARY RADIATION DEFECTS. Panov, V.I.; Smirnov, L.S. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.-Semicond. 7: No. 1, 154-156 (July 1973).

The temperature dependence of radiation defect production energy threshold in Si was studied. A collective process was found in the formation of primary defects in local regions. Results also show that the number of atoms in a local excitation region is ~60 and such regions extend over about five coordination spheres. The value of radiation defect formation energy threshold increases with increasing temperature and the number of defects formed at high temperature is large despite annihilation processes. (JRD)

5575 KINETICS OF RECOVERY OF LUMINESCENCE PROPERTIES OF GALLIUM ARSENIDE SINGLE CRYSTALS IRRADIATED WITH HIGH-ENERGY ELECTRONS. Bogdankevich, O.V.; Borisov, N.A.; Kalendin, V.V.; Kovsh, I.B.; Kryukova, I.V. Sov. J. Quantum Electron. 2: No. 5, 479-481 (Mar 1973).

An investigation was made of the kinetics of changes in the luminescence and laser properties of GaAs as a result of irradiation with 600-keV electrons (pulsed electron current density, 30 A/cm²) and subsequent annealing at 300°K. An increase in the intensity of the photoluminescence emitted by n-type GaAs:Te crystals and a reduction in the laser threshold value of the pumping current were observed. These changes depended on the density of the electron current, the total absorbed dose, and the parameters of the original crystals. No improvement was observed for undoped epitaxial samples. A qualitative explanation of the effects observed was put forward. (auth)

5576 DIFFERENTIAL THERMAL MICROANALYSIS. Determination of Free Li in Irradiated LiH. Barbier, P.; Bedere, S. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Bull. Inform. Sci. Tech. (Paris); No. 180, 39-42(Apr 1973). (In French).

A quantitative micro DTA apparatus, which can operate between 25 and 600°C, is described. The assembly, which can be used in temperatures up to 130°C, is used in a dry glove box. Thermograms obtained for irradiated lithium hydride established the existence of free Li, which precipitates during irradiation. The method is sufficiently sensitive to detect signals having amplitudes as small as 1×10^{-3}°C; the thermal effect for this amplitude is 5×10^{-5} calories. (FR)

5577 GROWTH OF COLOR CENTERS AND HARDENING OF CaF_2 BY HEAVY DOSE OF γ-IRRADIATION. Sashital, S. R.; Vedam, K. (Pennsylvania State Univ., University Park). Phys. Status Solidi (a); 19: No. 2, 625-634(16 Oct 1973).

The growth of color centers and the accompanying changes in the mechanical properties (flow stress, Vicker's microhardness, and dislocation mobilities) of CaF_2 single crystals due to γ-ray irradiation were studied in the dosage range of 10^4 to 5×10^8 R at room temperature. Of the four absorption band spectra with peaks at 225, 335, 400, and 580 nm observed, the 225, 400, and 580 nm bands were seen to saturate at about 10^5 R and remain saturated in the entire dosage range studied. On the other hand the 335-nm band, after initial saturation at $\approx 10^5$ R, was observed to start growing again at about 2×10^7 R. The observed changes in the mechanical properties are seen to correlate well with the growth of the 335-nm band. A tentative model is suggested for the color center responsible for the 335-nm band and the mechanical-property changes. (auth)

5578 CORRELATION BETWEEN ABSORPTION BANDS AND IMPLANTED ALKALI IONS IN LiF. Davenas, J.; Perez, A.; Thevenard, P.; Dupuy, C. H. S. (CNRS, Villeurbanne, France). Phys. Status Solidi (a); 19: No. 2, 679-686(16 Oct 1973).

Defects induced in LiF by bombardment with alkali ions in the 1 MeV energy range have been investigated by optical absorption measurements. In addition to the absorption bands of F and F-aggregate centers, new bands have been obtained after thermal annealings and have been attributed to implanted ion centers. The corresponding absorption band positions depend on the nature of the implanted ions and have been obtained at 520 nm for sodium ($C_A(Na^+)$ band) and 680 nm for potassium ($C_A(K^+)$ band). The comparison of these band positions with those of the colloidal centers created in NaCl and KCl by ion bombardment suggests that they are colloidal bands. It has been deduced from Doyle's theory that the C_A bands were due to the plasma resonance of quasimetallic particles formed after precipitation of the implanted ions. (auth)

5579 LEED STUDY OF THE (111) SURFACE OF β-RHOMBOHEDRAL BORON. Rovida, G.; Maglietta, M. (Univ., Florence). J. Appl. Phys.; 44: No. 8, 3801-3802(Aug 1973).

The LEED pattern characteristic of a regular structure of the (111) surface of β-rhombohedral boron was obtained after heating at temperatures higher than 1400°C. As indicated by Auger spectroscopy, this treatment is sufficient to eliminate oxygen and carbon, the main impurities present on the initial surface. A small amount of nitrogen remains on the surface. The LEED pattern observed in these conditions is in agreement with the unit mesh of the bulk (111) planes. (auth)

5580 PROCEEDINGS OF THE 21ST CONFERENCE ON REMOTE SYSTEMS TECHNOLOGY, SAN FRANCISCO, CALIFORNIA, NOVEMBER 11–16, 1973. Farmakes, R. (ed.). Hinsdale, IL; American Nuclear Society, Inc. (1973). 128p. (CONF-731111-).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973).

Eighteen papers were presented at the conference. One paper was presented orally at the conference but not included in the proceedings. A separate abstract was prepared for each of 14 papers. The remaining 3 papers have been previously abstracted in NSA. (RCK)

For abstracts of individual papers see: 5011–5013, 5548, 5627–5632, 6844, 6989, 6990, and 7228.

5581 IRRADIATION-INDUCED STRUCTURAL CHANGES IN CARBON FIBERS. Bullock, R. D.; Gordon, D. E.; Deaton, B. C. (General Dynamics, Fort Worth, TX). Carbon; 11: No. 4, 418-421(Aug 1973).

Results are presented on the effect of fast neutron irradiation on carbon fibres at −196°C, 75°C, and 175°C. Brief details are given of the materials tested and the measurement of structural parameters. The strong influence of irradiation temperature on resulting structural changes in the fibers is pointed out. (UK)

5582 GAMMA-RAY-INDUCED CONDUCTIVITY IN INSULATING POLYMERS. VI. Okamoto, S.; Furuta, J.; Hiraoka, E. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 94-98(Mar 1973).

The temperature dependence of induced electric current of polyethylene during and after cobalt gamma irradiation was measured. The data are different from those of Fowler and other workers. The data were analyzed using a recombination model in photoconductive insulators and semiconductors. It is found that the temperature dependence of induced current depends on the drift mobility and that the induced current of polyethylene is concerned with two different kinds of carriers. (auth)

5583 OPTICAL AND MAGNETIC RESONANCE SPECTRA OF INORGANIC MOLECULAR CRYSTALS—URANIUM BOROHYDRIDE [$U(BH_4)_4$] IN HAFNIUM BOROHYDRIDE [$Hf(BH_4)_4$]. Bernstein, E.R.; Keiderling, T.A. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 59: No. 4, 2105-2122 (15 Aug 1973).

The electronic absorption spectra of $U(BH_4)_4$ as a guest in $Hf(BH_4)_4$ host crystrals are reported. Optical spectra, from the charge transfer or f-to-d cutoff at approximately 2900 Å to the low energy limit due to host molecular vibrations at approximately 2.0μm, have been obtained at 300, 77, and 2°K for mixed crystals of $U(BH_4)_4/Hf(BH_4)_4$ and $U(BD_4)_4/Hf(BD_4)_4$. From temperature effects, deuteration shifts, and intensity patterns, over 20 possible forced electric dipole crystal field electronic origins have been identified. Several molecular vibrations have been identified built on these origins and, based on physically reasonable arguments, are tentatively associated with specific vibrational symmetries and motions of $M(BH_4)_4$ type molecules. Attempts to obtain EPR spectra between 2 and 77°K are discussed. Zeeman spectra in fields of up to 93.5 kG for the region 4000-75000 Å have been used to aid in the identification of both ground and excited electronic crystal field states. Calculations, based on a free ion and cubic crystal field parameterized Hamiltonian, are employed to assign electronic origins. The spectra are best fit to a crystal field model Hamiltonian whose two parameters $A_{40}\langle r^4\rangle$ and $A_{40}\langle r^4\rangle$ have their signs determined from considerations of 12 negative point charges at the hydrogen positions. Implications of these crystal field and vibrational analyses for actinide spectroscopy are discussed. (auth)

5584 RELATION OF NUCLEAR QUADRUPOLE COUPLING TO SPONTANEOUS POLARIZATION. Dening, D. Troy, NY; Rensselaer Polytechnic Inst. (1973). 54p. University Microfilms Order No. 73-27,202.

Thesis (Ph. D.).

Materials were obtained for the purpose of investigating the quadrupole coupling as a function of polarization. Only sodium nitrite was intensively studied because of experimental difficulties with the other materials. The relationship for $NaNO_2$ was proportional to the square of the polarization, as opposed to the linear correlation of Rochelle salt. The correlation between the polarization and quadrupole splitting can be predicted from the crystal symmetry of the ferroelectric. After explaining the correlation attempts were made to change the spontaneous polarization to see if this changed the quadrupole coupling as predicted. An electric field was applied across the sample and quadrupole coupling studied as a function of temperature. Then the material was damaged by a room temperature gamma ray irradiation of 1.1×10^5 R. (RWR)

5585 EFFECTS OF RADIATION STERILIZATION ON PLASTICS. Plester, D. W. (Imperial Chemical Industries, London). pp 141-152 of Industrial Sterilization. Phillips, G. B. (ed.). Durham, NC; Duke Univ. Press (1973).

From international symposium on industrial sterilization; Amsterdam, Netherlands (Sep 1972). See CONF-7209100-.

A review is given of the effects of sterilizing doses (5 Mrad and up) of radiations on plastics. Olefine polymers, acrylic polymers, vinyl polymers, fluorinated polymers, polyamides, poly(ethylene terephthalate), cellulose esters, thermosets, etc. are among the various plastics considered. Effects on rubbers, textiles and fibers, and adhesives and cements are also described. (26 references) (DLC)

5586 THERMAL AND ELECTRICAL CONDUCTIVITIES OF UNIRRADIATED AND IRRADIATED GRAPHITE FROM 300 TO 1000°K. Moore, J. P.; Graves, R. S.; McElroy, D. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 145-146(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5587 THERMAL CONDUCTIVITY OF ORIENTED FIBROUS CARBON INSULATION. Godfrey, T. G.; McElroy, D. L.; Ardary, Z. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 148(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5588 MEASUREMENT OF THE RATIO OF SPECIFIC HEATS OF UF_6. Sterritt, D. E. (Univ. of Florida, Gainesville); Lalos, G. T.; Schneider, R. T. Trans. Amer. Nucl. Soc.; 17: 191(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

5589 (K-1844) SURVEY OF AVAILABLE TECHNOLOGY FOR AUDITING ^{235}U ENRICHMENT IN CASCADE EQUIPMENT. Bailey, J. C. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 5 Nov 1973. Contract W-7405-eng-26. 89p. Dep. NTIS $6.50.

A search for possible nondestructive techniques which might be utilized by a safeguards inspection team for auditing ^{235}U enrichment of UF_6 in gaseous diffusion cascade equipment without access to the UF_6 itself was carried out at the ORGDP. The work included a literature survey of safeguards techniques in use by others, and a search for other methods or equipment which might be applied to the present objective. Various possible methods are evaluated briefly. Probable limited access to cascade equipment precludes the use of methods involving bulky equipment, including neutron and gamma generators, coincident or anti-coincident counters and high energy isotopic neutron sources of sufficient strength to produce a measurable fission rate in ^{238}U which requires large shields. Irradiation with low energy neutrons followed by detection of fission events and passive gamma measurements could provide information on the ^{235}U content, but not on the ^{238}U. Two methods upon which preliminary investigations were carried out are considered to warrant further development. The first involves a direct measurement of the ^{235}U gamma radiation from UF_6 within a pipe and a measurement of the absorption of gamma rays from an external gamma source when these rays pass through the pipe walls and UF_6. The ^{235}U gamma measurement indicates the amount of this isotope present, and the gamma absorption measurement, when corrected for pipe-wall absorption, indicates the total uranium present. Experimental tests indicated this method to be well within the scope of current technology. The tests included an evaluation of a commercially available ultrasonic gauge which could be used for pipe-wall thickness measurements. The second method involves the irradiation of the UF_6 with a moderated neutron source and the detection of gamma rays resulting from neutron capture in ^{238}U and fissions induced in ^{235}U. This method is considered to warrant further investigation, but its actual feasibility has not been established. (auth)

5590 NONDESTRUCTIVE ASSAY INSTRUMENTATION FOR IN-PLANT APPLICATIONS. Menlove, H. O. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 75(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5591 NONDESTRUCTIVE ASSAY APPLICATIONS IN THE NUCLEAR INDUSTRY. VanHoomissen, J. E.; Wilkins, D. R. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 17: 75-76(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5592 USE OF NDA INSTRUMENTATION IN URANIUM ENRICHMENT FACILITIES. Marshall, E. D. (Atomic Energy Commission, Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 17: 76-77(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5593 IN-PLANT APPLICATION OF NONDESTRUCTIVE INSTRUMENTATION: EXPERIENCE AND PROSPECTS. Higinbotham, W. A. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 77(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5594 COMPUTERIZED SYSTEM FOR NDA OF NUCLEAR FUELS BY X-RAY FLUORESCENCE AND GAMMA SPECTROSCOPY. Gunnink, R.; Pickles, W. L. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 77-78(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5595 NDA APPLICATIONS AT A PLUTONIUM PROCESSING FACILITY. Chanda, R. N. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 17: 78-79(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5596 ^{124}Sb–Be PHOTONEUTRON SYSTEM FOR FISSILE MATERIALS ASSAY. Forster, R. A. (Los Alamos Scientific Lab., NM); Menlove, H. O.; Matthews, D. L. Trans. Amer. Nucl. Soc.; 17: 80(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5597 ON-LINE ENRICHMENT MONITOR FOR LIQUID UF_6. Reilly, T. D.; Martin, E. R.; Parker, J. L.; Speir, L. G.; Walton, R. B. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 81(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5598 NONDESTRUCTIVE ASSAY OF HTGR-TYPE FUEL ELEMENTS. Augustson, R. H.; Malanify, J. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 81-82 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5599 CALIBRATION AND ERROR PROPAGATION FOR NONDESTRUCTIVE ASSAY INSTRUMENTATION. Smith, D. B.; Forster, R. A. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 82-83(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5600 ANALYSIS OF THE LEAD SPECTROMETER FOR NONDESTRUCTIVE FISSILE MATERIAL ASSAY. Sawan, M.; Conn, R. W. (Univ of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 83-84(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5601 TOWARD MATRIX INDEPENDENCE IN SINGLES GAMMA-RAY DRUM COUNTERS. Harlan, R. A.; Bidwell, L. A. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 17: 84(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5602 CORRECTIONS FOR ACCIDENTAL COINCIDENCE IN FISSION DETECTORS. Gozani, T. (Intelcom Rad Tech., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 84-85(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5603 ^{235}U ENRICHMENT DETERMINATION USING ^{4}He PROPORTIONAL COUNTERS. Caldwell, J. T.; Evans, J. L.; Fehlau, P. E.; Whittlesey, T. H. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 85-86(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5604 RECENT DEVELOPMENTS IN NUCLEAR FUEL CYCLE SAFEGUARDS. Bartels, W. C. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 300(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5605 DEVELOPMENT OF A FIELD VERIFIABLE FINGERPRINTED SECURITY SEAL. Sastre, C. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 302(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5606 PORTAL MONITOR FOR DIVERSION SAFEGUARDS. Sampson, T. E.; Fehlau, P. E.; Worth, G. M.; Henry, C. N. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 302(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5607 URANIUM ASSAY REQUIREMENTS OF NUCLEAR ACCOUNTABILITY AND SAFEGUARDS. Bingham, C. D.; Lerner, M. W. (Atomic Energy Commission, New Brunswick, NJ). Trans. Amer. Nucl. Soc.; 17: 303(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5608 CHEMICAL ASSAY OF PLUTONIUM FOR SAFEGUARDS. Jackson, D. D.; Rein, J. E.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 303-304(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Disposal and Storage

Refer also to abstracts 4967–4971 and 5196.

5609 (ARH-SA-166) RETRIEVABLE SURFACE STORAGE OF HIGH LEVEL RADIOACTIVE WASTES. Wodrich, D. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 9 Nov 1973. Contract AT(45-1)-2130. 17p. (CONF-731101-19). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A Retrievable Surface Storage Facility (RSSF) for the interim storage of solidified high-level nuclear wastes will be built for the USAEC at Richland to serve until a permanent waste repository is established. Design criteria for the RSSF are presented, and the three basic storage concepts currently being evaluated, i.e., storage in cooled water basins, in air-cooled concrete vaults, and in air-cooled steel casks, are discussed. (LCL)

5610 (ICT-9/70) STUDIES ON THE THERMAL AND MECHANICAL SENSITIVITY OF BITUMEN/OXYGEN-SALT MIXTURES. Backof, E.; Diepold, W. (Institut fuer Chemie der Treib- und Explosivstoffe, Berghausen/Karlsruhe (F. R. Germany)). 31 Dec 1970. 50p. (In German). INIS.

The experiments which are described were performed with the aim of being able to guarantee the safe handling of radioactive wastes containing nitrate salts during bitumization and transport. Thermal sensitivity (ignition temperature, duration of burning, heating in a sealed casing), mechanical sensibility (sensitivity to impact) and sensibility against detonative stresses were determined with samples which contained 40% bitumen and 60% alkaly-, alkaline earths-, and heavy metal nitrates, organic acids and rare earths. In addition, some β-irradiated non-active samples were studied in order to obtain some reference values. Whereas the inflammability of the bitumen is increased by nitrate addition, no explosion reaction was observed as a result of thermal or detonative stresses. (INIS)

5611 (INIS-mf-584) TREATMENT OF RADIOACTIVE WASTES PRODUCED IN THE NUCLEAR FUEL CYCLE OUTSIDE NUCLEAR POWER STATIONS. van de Voorde, N. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 23p. (In Dutch). INIS.

Radioactive wastes are produced in each step of the fuel cycle; 99% of the waste, however, is produced during the fuel reprocessing. The treatment of the different types of wastes as effluents, solid or gaseous wastes is described. The storage and definitive elimination of the wastes, which problem is not yet completely dissolved, is discussed. Several possibilities, such as engineered storage and storage in geological formations (salt mines, granite formations, ice formations in artic regions), are considered. (INIS)

5612 (N-73-24834) SUMMARY OF THE STUDY OF DISPOSAL OF NUCLEAR WASTE INTO SPACE. Rom, F. E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 14p. (NASA-TM-X-68235). NTIS.

The space shuttle together with expendable and nonexpendable orbital stages such as the space tug or Centaur can safely dispose of waste material by ejecting it from the solar system. The safety problems associated with all phases of launching and operation (normal, emergency, and accident) of such a system are being examined. It appears that solutions can be found that should make the risks acceptable when compared to the benefits to be obtained from the disposal of the nuclear waste. The techniques proposed to make such a system acceptable need to be carefully verified by further study and experiment. (auth)

5613 PROJECTIONS OF RADIOACTIVE WASTES FROM THE NUCLEAR FUEL CYCLE. Blomeke, J. O.; Kee, C. W. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 324-325(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5614 ALTERNATIVE MEANS OF ULTIMATE HIGH-LEVEL WASTE MANAGEMENT. Schneider, K. J.; Jarrett, J. H. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 325-326(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5615 RETRIEVABLE SURFACE STORAGE OF HIGH-LEVEL RADIOACTIVE WASTES. Wodrich, D. D. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 326 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5616 IMPROVED HEAT TRANSFER FROM RADIOACTIVE WASTE CANISTERS. Jansen, G.; Kaser, J. D. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 327 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5617 RADIOACTIVE WASTE PRODUCT FORM DURABILITY EVALUATION. Brownell, L. E.; Isaacson, R. E.; Kindle, C. H. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 327-328(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5618 POST-IMPACT ANALYSIS OF NUCLEAR-WASTE SPACE DISPOSAL CONTAINERS. VanBibber, L. E.; Parker, W. G. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 328-329(Nov 1973).

From joint meeting of the American Nuclear Soc " and the Atomic Industrial Forum and Nuclear Energy Exhi ; San Francisco, California, USA (11 Nov 1973). See C(31101-.

5619 NUCLEAR BY-PRODUCT HEAT GENERATION RATES FOR AN ADVANCED-DESIGN HIGH-TEMPERATURE GAS-COOLED REACTOR. Angelo, J. A. Jr. (Air Force, Patrick AFB, FL); Post, R. G.; Haskin, F. E. Trans. Amer. Nucl. Soc.; 17: 329 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5620 CONCRETE-POLYMER MATERIALS APPLIED TO LONG-TERM STORAGE OF RADIOACTIVE WASTE. Steinberg, M.; Colombo, P.; Manowitz, B. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 333-334(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5621 ENGINEERED DRY-STORAGE FACILITY FOR IRRADIATED GRAPHITE MATRIX FUELS. Bingham, G. E. (Allied Chemical Corp., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 513(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Handling Equipment and Procedures

Refer also to abstracts 5005–5007, 5011, 5018, 5019, 5621, 6844, 6989, 6990, and 7228.

5622 (CONF-720823-P2, pp 551-583) ENGINEERING A NEW RELIABLE ALPHA-CONTAINING FILTERED EXHAUST GAS SYSTEM. Fuller, A. B. (Oak Ridge National Lab., TN). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A reliable exhaust system was designed to ventilate gloved enclosures in an existing building which was modified to provide for the safe handling of kilogram quantities of alpha-emitting materials. The new exhaust system was designed especially for this purpose, and as a separate system, it relieved the existing overtaxed exhaust systems which could not be economically upgraded to perform the same function. The arrangement of components and the features incorporated in the new system provide many improvements in reliability and maintenance not found in other systems of this type. The more significant events experienced during the design, fabrication, and installation of this system, beginning with the design criteria and ending with an objective critique for the benefit of others, are discussed. (auth)

5623 (CONF-720823-P2, pp 584-594) WASTE ENCAPSULATION AND STORAGE FACILITY VENTILATION SYSTEM. Rice, E. D.; Caldwell, C. G. (Vitro Engineering, Richland, WA). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The design is described for the ventilation and filtration requirements for Hanford's Waste Encapsulation and Storage Facility. This design complies with the highest standards of quality assurance and licensability. The encapsulation and underwater storage of ^{137}Cs and ^{90}Sr is part of the management program at Hanford for the safe disposition of radioactive wastes. It has been necessary to design a special facility to handle the large quantities of these materials at high production rates (30 MCi of ^{90}SR and 30 MCi of ^{137}Cs). The air-handling and air-cleaning systems in this facility are essential to the operation of the encapsulation facility. The building's atmosphere is maintained at negatively zoned pressures varying from −0.05 in. to −1.5 in. water gauge in the working areas. (auth)

5624 (CONF-720823-P2, pp 619-637) ADEQUACY OF VENTILATION EXHAUST FILTERING SYSTEM FOR NEW PLUTONIUM FACILITIES. Hetland, N.; Russell, J. L. Jr. (C. F. Braun and Co., Alhambra, CA). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

As a part of the conceptual design studies for a New Plutonium Recovery Facility for the AEC Rocky Flats Plant, a special study was made to determine the requirements for adequate ventilation exhaust filtering systems. The new AEC Minimum Criteria for New Plutonium Facilities, dated April, 1971, establishes some very stringent requirements for such ventilation systems. These new criteria require that concentrations of soluble plutonium in the exhaust gases at the exit from the building shall not exceed the allowable limits set forth in AECM 0524, and that the exhaust ventilation systems providing confinement shall continuously perform throughout the design basis accidents that can be postulated for the facility, including those resulting from natural phenomena such as earthquake and tornado. This study was accomplished in three steps. The first was a study of existing systems. The second consisted of mathematically analyzing model systems, one based on data from similar operating systems, and one based on recent theory. The models were compared. The third step consisted of developing systems having comparable decontamination capabilities using HEPA and deep-bed sand and fiberglass filters. These were compared for cost and safety. Considerations included the nature and characteristics of the plutonium aerosol, the mechanics of filtration, corrosives in the exhaust stream, filter fire protection, system earthquake resistance, tornado protection, maintainability and reliability. It was concluded that filtering systems can be built to provide the necessary decontamination factors on a continuous, reliable and safe basis, with adequate fire protection and protection from earthquake and tornado forces. It was also concluded that there is a lack of direct operating data with plutonium that can be applied for design purposes, and that a program of testing and recording of actual operating data is necessary. (auth)

5625 (CONF-720823-P2, pp 770-785) ENGINEERING ASPECTS OF PLUTONIUM FACILITY AIR CLEANING INSTALLATIONS. Russell, J. L. Jr. (C. F. Braun and Co., Alhambra, CA). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Some of the problems involved in developing adequate and safe ventilation systems which are an essential part of safe and more efficient Pu handling facilities are discussed. (LCL)

5626 (CONF-720823-P2, pp 817-827) FILTER TESTING DEVELOPMENTS IN GREAT BRITAIN. Dorman, R. G. (Chemical Defence Establishment, Porton Down, Eng.). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Most HEPA filter testing in the United Kingdom is carried out with an aerosol of sodium chloride. The aerosol, of mass median diameter 0.65μm, is generated by pressure atomization of a 2% salt solution and, in the original Porton design, is detected by hydrogen flame photometry. A variation of the method was developed at Harwell; in this variation a cadmium sulfide cell is used as detector, instead of a photomultiplier. Recent improvements to the Porton design permit testing of filters of less than 0.0001% penetration at flow rates of 1000 cfm. Work at the Atomic Weapons Research Establishment, Aldermaston, has been devoted to the design of a thermal generator of sodium chloride aerosols, giving a compact device for use in in-place testing in conjunction with the standard sodium flame detector. (auth)

5627 ANALYTICAL ZONING OF MANIPULATOR COVERAGE. Vertut, J. (CEN de Saclay, Gif-sur-Yvette, France); Guilbaud, J. P.; Germond, J. C.; Seran, R.; Ducondi, A. Conf. Remote Syst. Technol., Proc.; No. 21, 28-37(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

The combined limitations of viewing and handling an object within a cell were analyzed. Also, the limitations of orienting an object, based on its location within the cell, were described. From the extreme reach position of the manipulator, where the tong can only twist an object, successive concentric zones were described in which an object can be oriented to pan an increasing angle and tilt from the horizontal to the vertical (movement around the tong center). This allows a better compared zoning of manipulators with different geometry. (auth)

5628 CONTRIBUTION TO DEFINE A DEXTERITY FACTOR FOR MANIPULATORS. Vertut, J. (CEN de Saclay, Gif-sur-Yvette, France); Papot, L.; Rossignol, C.; Tiret, A. Conf. Remote Syst. Technol., Proc.; No. 21, 38-46(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

A study has been started to compare the effective dexterity of different manipulators so improvements can be made. This preliminary study proposes a classification of successive slowing factors due to viewing, the manipulator itself, the master terminal, etc. The next consideration was a strategy showing effects compared to a man performing the same task by hand. The first data are compatible with the work of others, and open the way to further work. The study emphasizes the importance of force reflective control. (auth)

5629 MANIPULATOR AS A MEANS OF EXTENDING OUR DEXTEROUS CAPABILITIES TO LARGER AND SMALLER SCALES. Flatau, C. R. (TeleOperator Systems, Shoreham, NY). Conf. Remote Syst. Technol., Proc.; No. 21, 47-50(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

It has become apparent that manipulators are a viable means of extending our dexterous capabilities to large as well as small working scales. Detailed studies of the requirements and design principles for a 40-ft-long, bilateral force-reflecting (BFR) manipulator were contrasted to those for an 8-in.-long, force-sensing, mini-robot arm. In both cases, extensions and scaling of the technology of BFR manipulators were applied. (auth)

5630 ENGINEERED DRY-STORAGE FACILITY FOR IRRADIATED GRAPHITE MATRIX FUELS. Bingham, G. E. (Allied Chemical Corp., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; No. 21, 78-85(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

A facility is being built at the Idaho Chemical Processing Plant to provide safe, dry storage for a large number of irradiated fuel elements from several high-temperature gas-cooled reactors, including Fort St. Vrain, Peach Bottom, Rover, and possibly future HTGRs. The facility has been specially designed so all fuel handling, cutting, and storing is performed remotely through the use of specialized tools and equipment. In addition, the facility is designed so contact maintenance on all the operating equipment can be performed in a low radiation environment. The facility will be operational in mid-1974. (auth)

5631 COLD TRAP FOR REMOVAL OF IMPURITIES FROM INERT-GAS SYSTEMS USED WITH SHIELDED DRY BOXES. Lazarus, M. E.; Mason, P. A. Jr. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; No. 21, 113(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

The operation of a cold trap used at the LASL Hot Cell Facility for removing large quantities of organic chemicals which are present in the cell atmosphere as a result of processing metallographic specimens and which are detrimental to plastic materials used in the cells is described. The unit consists of a 1½-hp refrigeration compressor and a copper finned-copper tube heat exchanger in a sealed liquid collection vessel. Operating at −50°F with 60% flow-thru, the level of butyl acetate in the cell can be brought down to less than 300 ppM. (LCL)

5632 FISSION GAS COLLECTION AND STORAGE SYSTEM. Altamari, L. A. (Knolls Atomic Power Lab., Schenectady, NY). Conf. Remote Syst. Technol., Proc.; No. 21, 114(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

A system designed to store fission gases released from cladding punctures in irradiated fuel elements is described. The fission gas storage system consists of two shielded cryosorption pumps located out-of-cell in a ventilated enclosure and is used in conjunction with a remote vacuum drilling apparatus which is used to puncture the fuel cladding. When a pump has reached its storage limit capacity it is removed from service for 90 days to allow decay of short half-life isotopes, after which time the pump contents are transferred to a cylinder for disposal. (LCL)

5633 CRITICAL EXPERIMENTS TO MEASURE THE NEUTRON POISONING EFFECTS OF Cu AND Cu−Cd PLATES. Bierman, S. R.; Lloyd, R. C.; Clayton, E. D. (Battelle Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 265(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5634 ARRAY CRITICAL EXPERIMENTS WITH MATERIALS USED IN SHIPPING CONTAINERS. Magnuson, D. W. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 17: 265-266(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5635 LIGHT-WATER-MODERATED REACTIVITY OF TUBULAR SLUG PAIRS CONTAINING 1.1 wt. % ENRICHED URANIUM. Smotrel, J. R. (E. I. du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 266-267(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5636 SHORTCOMINGS OF THE ALBEDO APPROXIMATION IN KENO CALCULATIONS. Long, J. K. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 267-268(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5637 MONTE CARLO ANALYSIS OF EXPERIMENTALLY CRITICAL PIPE INTERSECTIONS. Cross, N. F.; Whitesides, G. E.; Hinton, R. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 268(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5638 KENO CALCULATIONS PERTAINING TO INTERACTION BETWEEN LOW-ENRICHED FISSILE ARRAYS. Welfare, F. G. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 268-269(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5639 CRITICALITY OF PLUTONIUM−URANIUM NITRATE SOLUTIONS CONTAINING 30 wt. % Pu. Lloyd, R. C.; Clayton, E. D. (Battelle-Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 269-270(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5640 CRITICALITY CONTROL FOR MULTIPLE ARRAY OF LIGHT WATER REACTOR FUEL. Ridihalgh, J. L. (Battelle Memorial Inst., Columbus, OH). Trans. Amer. Nucl. Soc.; 17: 275-277(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5641 MINIMUM CRITICAL CONCENTRATION OF ^{239}Pu. Clark, H. K. (E. I. du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 278-279(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5642 REEXAMINATION OF THE VALUE FOR THE MINIMUM CRITICAL CONCENTRATION OF ^{239}Pu IN WATER. Richey, C. R. (Battelle-Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 279-280(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5643 DESIGN CONSIDERATIONS IN REDUCING IN-PLANT DOSES. Nelson, R. A.; LaVallee, J. C. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 17: 386-387 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5644 70-mm ROLL FILM CAMERA SYSTEM FOR REMOTE METALLOGRAPHY. Gruber, W. J. Trans. Amer. Nucl. Soc.; 17: 507(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5645 ANALYTICAL ZONING OF MANIPULATOR COVERAGE. Vertut, J. (CEA, Paris); Guilbaud, J. P.; Germond, J. C.; Seran, R.; Ducondi, A. Trans. Amer. Nucl. Soc.; 17: 510(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5646 CONTRIBUTION TO DEFINE A DEXTERITY FACTOR FOR MANIPULATORS. Vertut, J. (CEA de Saclay, Gif-sur Yvette, France); Papot, L.; Rossignol, C.; Tiret, A. Trans. Amer. Nucl. Soc.; 17: 510(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5647 MANIPULATOR AS A MEANS OF EXTENDING OUR DEXTEROUS CAPABILITIES TO LARGER AND SMALLER SCALES. Flatau, C. R. (TeleOperator Systems, Shoreham, NY). Trans. Amer. Nucl. Soc.; 17: 510(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5648 REMOTE MAINTENANCE EXPERIENCE IN THE TRANSURANIUM PROCESSING PLANT AT ORNL. Peishel, F. L.; Evans, W. W.; Matherne, J. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 512-513(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Transportation

5649 (ARH-SA-168) DESIGN IMPROVEMENTS IN THE L-10 SHIPPING CONTAINER. Curren, E. F. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 11 Nov 1973. 9p. (CONF-731101-26). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The U. S. Atomic Energy Commission (AEC) is considering an amendment to 10 CFR71 which would ban the shipment of plutonium nitrate solutions in quantities in excess of 20 curies and make mandatory the shipment of plutonium as the oxide, packaged in containers which meet special form requirements. In view of the considered action by the AEC, a review of the history of the L-10 shipping container, improvements in its design, shipping experience and other factors, is presented. It is concluded that the L-10 shipping container design provides the high degree of safety necessary for the protection of the public in the transport of plutonium nitrate solutions. (TFD)

5650 (ARH-SA-172) PACKAGING AND TRANSPORTATION OF PLUTONIUM FROM FUEL PROCESSING PLANTS. Hoover,

D. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 12 Nov 1973. Contract AT(45-1)-2130. 6p. (CONF-731105-7). Dep. NTIS $3.00.

From winter meeting of American Society of Mechanical Engineers; Detroit, Michigan, USA (11 Nov 1973).

The characteristics of plutonium which are of concern to the packager, the "state of the art" in packaging Pu for transport, and problems associated with high exposure Pu which must be solved are discussed. (auth)

5651 (LCA-NT-220-E-T) RADIOPROTECTION OF CYLINDRICAL CONTAINERS. Warme-Janville, B. (Laboratoire Central de l'Armement, 94-Arcueil (France). Dept. Detection Protection Nucleaire). 25 Sep 1972. 92p. (In French). Dep. NTIS (U. S. Sales Only) $6.75.

The results of a systematic study of the shielding properties of cylindrical containers for the transport of radioactive sources or radioactive wastes is presented. The shielding characteristics are calculated for depleted uranium and lead walls (taking into account the inner and outer metallic vessels and the thick (4 cm) plaster fireproof wall). The container has a volume of between 26 and 28 liters and a diameter varying between 25 and 40 cm. (FR)

5652 (SLA-73-930) DESIGN CONCEPTS STUDY OF A SPECIAL NUCLEAR MATERIAL CARGO VEHICLE. Reed, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 14p. Dep. NTIS $3.00.

Design concepts formulated to provide a basis for the design of a secure vehicle for surface transport of special nuclear materials are described. The design features are to provide for vehicle immobilization and penetration resistance consistent with AEC requirements for increased protection against theft or diversion. The study objectives and parameters and a preliminary estimate of cost are included. (auth)

5653 PACKAGING FOR THE TRANSPORT OF IRRADIATED FUEL ELEMENTS. (to Commissariat a l'Energie Atomique). French Patent 2,145,361. 9 Jul 1971. 7p. (In French).

A packaging for the transport of irradiated fuel elements is described which is provided with a shell containing several cells plugged with lead stoppers. These cells are filled with a packing gas for transport purposes. The space between the shell and the cells is filled with water and contains lead bolts and heat exchangers joined in a movable manner to an external radiator. This space is closed with a lid which is bolted to the shell and by a lead plug. A partial evacuation of the heat with a thermosiphon may be envisaged. (FR)

5654 CRITICALITY SAFETY EVALUATION OF WOODEN PALLETS FOR TRANSPORTING N-REACTOR FUEL. Toffer, H.; McNeece, J. P.; Fowler, K. L. (United Nuclear Industries, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 272-273(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5655 PACKAGING OF LWR FUEL ASSEMBLIES FOR TRANSPORT. Hansen, L. E.; Nilson, R. (Exxon Nuclear Co., Inc., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 273-274 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5656 PACKAGING FOR FFTF, DRIVER FUEL PINS AND ASSEMBLIES. Edgar, J. B. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 274-275(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5657 ENGINEERING APPROACH TO CRITICALITY SAFETY ANALYSIS IN AN IRRADIATED FUEL CASK. Rollins, J. D. (Nuclear Assurance Corp., Atlanta); Best, R. E. Trans. Amer. Nucl. Soc.; 17: 277(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5658 DOT-6M PACKAGES FOR THE SHIPMENT OF PuO_2. Adcock, F. E. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 17: 280-281(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5659 CRITICALITY CALCULATIONS FOR TWO PLUTONIUM SHIPPING CONTAINERS. Ernst, B. B. (Nuclear Materials and Equipment Corp., Apollo, PA). Trans. Amer. Nucl. Soc.; 17: 281-282(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5660 EVALUATION OF ORNL FOAMGLAS SHIPPING CONTAINER. Parrott, J. R.; Shappert, L. B. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 282-283(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5661 DESIGN IMPROVEMENTS IN THE L-10 SHIPPING CONTAINER. Curren, E. F. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 283(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5662 SUMMARY OF DESIGN CONCEPTS STUDY OF A SPECIAL NUCLEAR MATERIAL CARGO VEHICLE. Reed, R. E. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 17: 300-301(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5663 SYSTEM FOR COMMUNICATION WITH COMMERCIAL SNM SHIPMENTS. de Montmollin, J. M.; Sellers, T. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 17: 301 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5664 DROP TEST QUALIFICATION OF THE EXXON NUCLEAR FUEL SHIPPING CONTAINER. Waymire, G. R. (Exxon Nuclear Co., Inc., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 320-321(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5665 INTERNAL POLYTROPIC COMPRESSION AS DOMINANT DAMPING PROTECTION DURING FUEL ELEMENT IMPACTS. Kondic, N. N. (Westinghouse Electric Corp., Tampa, FL). Trans. Amer. Nucl. Soc.; 17: 395-396(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

PARTICLE ACCELERATORS

Design, Development, and Operation

5666 (BNL-18330) STATUS REPORT ON POST CONVERSION AGS AND FUTURE DEVELOPMENTS AT THE AGS. van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 18p. (CONF-731115-3).

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

Recent AGS performance results are presented and details are given regarding 200-MeV linac injector parameters, multiturn injection, longitudinal and transverse intensity dependent effects and the status of modified and new external beam systems at the AGS. Development work in progress and under consideration for further improvement of the AGS performance and utilization potential for physics is outlined. (auth)

5667 (CONF-731115-4) COMMISSIONING AND UTILIZATION OF A SYNCHROTRON FOR HIGH ENERGY PHYSICS RESEARCH. Martin, J. H. (Argonne National Lab., Ill. (USA)). 1973. 14p. Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

A general outline for the organization and planning for the design and utilization of synchrotrons for high-energy physics research is given. Topics include establishing goals, execution of design and construction, facilities for high-energy physics, and management of the high-energy physics facility. (WHK)

5668 (DNPL/NSF/R-5) INTERNATIONAL CONFERENCE ON THE TECHNOLOGY OF ELECTROSTATIC ACCELERATORS, DARESBURY, 4–7 MAY 1973. Proceedings. Aitken, T. W.; Tait, N. R. S. (eds). (Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). 1973. 436p. (CONF-730530-).

Separate abstracts were prepared for 34 of the 37 papers presented. Three papers were previously abstracted in NSA as 28:13431, 11375, and 11379. (WHK)

For abstracts of individual papers see: 5242, 5669–5687, 5693–5701, 5708, 5711, 5712, 6047, and 6048.

5669 (DNPL/NSF/R-5, pp 3-13) NUCLEAR STRUCTURE FACILITY AT DARESBURY. Voss, R. G. P. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The present status in the field of electrostatic accelerators is briefly reviewed, with particular reference to the building of a major new nuclear structure facility in the UK, taking the form of a tandem accelerator capable of operating at up to 30 MV, and capable of accelerating all varieties of ions. This will probably be built at Daresbury. Supporting work at various UK Atomic Energy Authority Establishments and Universities is described. The main features of the new accelerator are briefly described. The fundamental physical dimensions were chosen conservatively and improving technology in future years should allow considerable upgrading. The design allows for extension of the experimental areas, for a long neutron time-of-flight beam, for the addition of a radiochemistry facility, and perhaps eventually for a cyclotron or some sort of linac. A pilot machine capable of fairly high voltages is at present being built. Work is starting on one of the most crucial aspects of such machines, accelerator tubes. (UK)

5670 (DNPL/NSF/R-5, pp 14-23) CHARACTERISTICS AND PERFORMANCE OF THE SAO PAULO PELLETRON ACCELERATOR. Sala, O.; Spalek, G. (Univ., Sao Paulo, Brazil). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The first parts of the Sao Paulo 4 U + 8 UD Pelletron accelerator facility arrived in March 1971. Voltage and beam tests were performed in November 1971, and proton energies of 22 MeV were achieved in April 1972; the 8 UD accelerator and all beamline components have been ready for operation since November 1972. The 8 UD accelerator is described. The 4U is being prepared for reliability tests. Details are given of operation and maintenance during a total of 1747 hours, together with machine characteristics, and details of the beam transport system. Some problems have been encountered, but have been quickly resolved. Charging chain breakage remains a problem. The machine has the advantages of ease of operation, simplicity, sturdiness, and good performance. (UK)

5671 (DNPL/NSF/R-5, pp 26-45) UNIVERSITY OF ROCHESTER MP TANDEM UPGRADING PROGRAMME. Purser, K. H. (Univ. of Rochester, NY). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

It is stated that the MP tandem Van de Graaff is the most versatile electrostatic accelerator at present in service, but it has always been unable to sustain reliably terminal voltages significantly greater than 10 MV. Because of this it has always been operated close to its design voltage limits, and has developed a reputation of poor reliability. Study of the problems has led to the belief that they can be rectified by making a few fundamental, but comparatively minor, changes in the design. Such changes are described, together with their background, and it is thought that the machine will soon operate reliably at terminal voltages in excess of 13 MV. Topics discussed include stored energy and transmission line effects, use of radial resistive terminals and terminal spinning, tube discharges and separate resistor chains, grading resistor protection, design of accelerator tubes, terminal pumping and column modifications. A statistical evaluation of the generator performance is shown over 1970 to 1972, and the improvement of operating performance with time is clear. (UK)

5672 (DNPL/NSF/R-5, pp 48-58) UPGRADING OF THE CHALK RIVER MP TANDEM FOR 13 MV OPERATION. Burn, N.; Andrews, H. R.; McDonald, A. B.; Milton, J. C. D. (Chalk River Nuclear Labs., Ont.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

During 1972 the accelerator was upgraded by the installation of a set of stainless steel electrode high-gradient accelerator tubes, and has operated routinely since then in the region of 11 to 13 MV, with one experimental run at 13.7 MV. The transmission of the tubes is between 40 and 50% for protons and all heavy ions from a direct extraction duoplasmatron or a Heinicke-Penning source, and about 20% for He ions from a charge exchange duoplasmatron. High voltage breakdown seldom occurs below 11 MV, but between 12 and 13 MV breakdowns occur several times a day, occasionally reaching 10 per day with heavy loading from ion beams. The upgrading programme consisted of high voltage tests of the column structure without tubes, and installation and testing of the new tubes. Details are given of the high voltage tests of the column structure, installation of the new tubes and associated equipment, testing of the new tubes, other recent additions to the accelerator, and operation with the new tubes. (UK)

5673 (DNPL/NSF/R-5, pp 61-64) DEMOCRITOS T11/25 HIGH INTENSITY TANDEM ACCELERATOR FACILITY. Assimakopoulos, P. A.; Valamontes, S. (Democritus Nuclear Research Centre, Athens). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The design and operation of the Democritos T11/25 tandem Van de Graaff accelerator are described. Energy and beam intensity characteristics of the accelerator for protons and deuterons are listed. (WHK)

5674 (DNPL/NSF/R-5, pp 66-74) COMMENTS ON THE OPERATION OF THE FLORIDA STATE HIGH GRADIENT FN TANDEM. Chapman, K. R. (Florida State Univ., Tallahassee). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The accelerator passed its acceptance test in September 1970. It was one of the first of a new generation of high gradient machines to be built by the American High Voltage Engineering Corporation. Another accelerator of the same type was built for Denmark, and these machines were, in effect, the prototypes leading to the upgrading kits now available for MP tandems. The Florida machine has been tested to 10 MV and is being used for experimental work at up to 9.5 MV. The mechanical problems encountered are described. The stainless steel tubes have worked well, but some problems were involved. Some glass damage has occurred in the column structures, but this does not limit the performance of the accelerator. Other matters discussed include grading resistors and column currents, the charging system, and the Heinicke source. (UK)

5675 (DNPL/NSF/R-5, pp 77-85) NUCLEAR STRUCTURE FACILITY AT THE AUSTRALIAN NATIONAL UNIVERSITY. Titterton, E. W. (Australian National Univ., Canberra). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

A description is given of the Cyclo-Graaff system and the 14 UD Pelletron machine that forms part of this facility. A fixed energy (protons 26.1 MeV, deuterons 14.2 MeV) negative ion sector focussed cyclotron is used as an injector to an EN-tandem accelerator to form the Cyclo-Graaff combination, yielding proton energies up to 38 MeV and deuteron energies up to 26 MeV. The type 14 UD vertical tandem machine is approaching beam tests. (UK)

5676 (DNPL/NSF/R-5, pp 89-99) DESIGN AND NEW FEATURES OF A THREE-STAGE TANDEM AT KYUSHU UNIVERSITY. Isoya, A. (Kyushu Univ., Fukuoka). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

A three-stage tandem machine is under construction at Kyushu University, Japan. An existing 7 MV vertical Van de Graaff is to be used as the first stage; the main part of the project is the construction of a 10 MV tandem with horizontal columns for the second and third stages. Completion of the whole project is scheduled for 1975. The general design features of the tandem are described, together with a detailed description of the design of the horizontal column structure and planning of the beam system. (UK)

5677 (DNPL/NSF/R-5, pp 101-111) OPERATING EXPERIENCE WITH THE MINNESOTA TANDEM VAN de GRAAFF. Broadhurst, J. H. (Univ. of Minnesota, Minneapolis). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The Model MP tandem Van de Graaff has operated since 1966 under a USAEC contract for studies in nuclear structure. It has accumulated over 40,000 hours of running time and no serious problems have arisen in its operation, although some difficulties have appeared. Solutions adopted to overcome these difficulties are outlined. A description is given of the mechanical and electrical structure of the machine. Some difficulties have arisen with the charging system and the accelerating tubes. Modifications and additions are described. (UK)

5678 (DNPL/NSF/R-5, pp 117-119) VOLTAGE TESTS OF A MP GENERATOR IN PURE SF_6. Letournel, M.; Oberlin, J. C. (Centre de Recherches Nucleaires, Strasbourg). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Some generator tests on the CRN Strasbourg Model MP 10 machine undertaken in March 1972 are described. At first it was easy to reach 14 MV, but the machine was sparking and unstable, and after a time marked deterioration of the voltage behavior occurred and the machine sparked even at 7 MV. In many places the column structure showed continuous discharges and flashings, which remained visible even at very low voltage. A lot of grey and white dust was formed inside the machine, especially at loose fittings and connections; this was shown to be a mixture of Al_2O_3 and AlF_3. After a period of maintenance, however, including tightening of loose contacts, no continuous discharge re-occurred and no more dust was found. Following maintenance, 17 MV was easily obtained in tests. An almost linear variation of voltage with SF_6 pressure was obtained. (UK)

5679 (DNPL/NSF/R-5, pp 165-175) INVESTIGATION INTO THE ELECTROMAGNETIC MODES OF VAN de GRAAFF STRUCTURES. Staniforth, J. A. (Univ. of Salford, Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

When spark breakdown occurs in a Van de Graaff accelerator, voltage surges are produced, and the electric field associated with these surges propagates in the machine. Resonances may be produced, or secondary breakdown may occur at modal points remote from the initial breakdown. The method of analysis of electromagnetic modes is outlined and in particular it is shown that modes with field variations around the stack are possible and are most likely to be present under surge conditions. The analysis has been confirmed by experimental data obtained from models. (UK)

5680 (DNPL/NSF/R-5, pp 200-207) ELECTROSTATIC DESIGN AND ACCELERATION TUBES IN THE 5 MV VAN de GRAAFF GENERATOR OF THE ATOMKI. Koltay, E.; Kiss, A. (Inst. of Nuclear Research, Debrecen, Hungary). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Reference is made to a single ended 5 MV Van de Graaff generator which has been built and tested up to the rated voltage at the Atomki Institute. The basic ideas concerning electrostatic design and acceleration tube structure are compared with the experimental results obtained during the test runs. A new electrode system comprising a high voltage terminal in the form of a third order paraboloid of rotation matching to a spherical calotte, with rings of oval cross section, was found to be an optimum configuration. Calculated field strength values are given. Only small differences in field strengths on the electrode surface were found, together with a strong screening effect on the first few rings of the column; this is very important in avoiding ring-to-tank breakdowns. A detailed description is given of acceleration tube construction. The rated energy of the machine was attained with an inclined field tube, using N_2 as insulating gas at a pressure of 0.9 MN/m^2. Under similar conditions 4.85 MV was obtained with a conventional tube. Use of the inclined field tube resulted in a large reduction in conditioning time, the maximum voltage being attained in a few hours. Focussing conditions and beam stability were also improved. There was also a large reduction in x-ray intensity. (UK)

5681 (DNPL/NSF/R-5, pp 223-232) OIL-IMMERSED RIGHI TYPE ELECTROSTATIC CHAIN GENERATOR. Secker, P. E.; Starr, K. W. (University Coll. of North Wales, Bangor). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The current interest in induction-charged chain generator high voltage Van de Graaff machines stems primarily from claims for greater stability than equivalent corona-charged insulating belt generators. The principal differences between the two systems are described. Insulating belt machines, however, are mechanically simpler than induction-charged generators, and for a given belt chain size and speed have a greater effective surface area for charge transport, and thus yield a higher current output. At first sight it would appear that the insulating belt arrangement should give rise to a very stable output, as charge arrives continuously at the collector terminal. By comparison the charge in the chain generator is localized on discrete segments and "segment ripple" might be expected in the output, but this can be designed out by careful shaping of the collector electrode. The essential difference between the induction and corona-charged generator systems is in the role of the insulating fluid. For a conventional Van de Graaff generator the fluid must have good insulating properties throughout the bulk of the machine but must act as a good conductor in the charging and discharging regions; whereas in induction-charged machines the insulating fluid must merely show good dielectric properties in all parts of the system and does not suffer from the conflicting requirements of corona-charged systems. As a result consistent charging and discharging, and hence a stable output, can be obtained. A study to demonstrate the viability of using a liquid as the insulating fluid for compact high voltage generators of up to 1 or 2 MV output is described. Use of a liquid rather than pressurized gas allows good operating stresses to be obtained without the expense of a pressure vessel or pressurized gas handling equipment; the serious erosion associated with sparking in pressurized gas also seems to be eliminated. The price to be paid for oil filling is, however, poor energy conversion efficiency due to viscous losses. The system is known as the Righi system, and its detailed design is described, together with experimental results and analysis of generator performance. Preliminary tests appear to indicate that such generators may have a useful role as simple sources of modest voltage output. (UK)

5682 (DNPL/NSF/R-5, pp 233-241) CHARGING SYSTEM WITH PELLET CHAINS. Isoya, A. (Kyushu Univ., Fukuoka). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

A charging system using pellet chains was developed several years ago at Kyushu University for use with an existing Van de Graaff generator. The system has operated successfully for the past three years, but considerable effort is being made towards improvement of the pellet chain and its associated devices for use with a tandem generator under construction. A description is given of the construction of the pellet chains and their driving mechanism and the inductive charging system, together with the performance of the machine. The pellets are of stainless steel, assembled on an insulated card made by molding neoprene rubber around a polyester fibre string. The card is only 3.5 mm in width, but can withstand a tensile force of 10^4 N. (UK)

5683 (DNPL/NSF/R-5, pp 242-253) STUDIES IN INDUCTION CHARGING AT READING. Allen, W. D.; Joyce, N. G. (Univ. of Reading, Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Induction charging systems have become accepted as alternatives to the belt transport systems of conventional Van de Graaff machines and the chief case for such systems is that they pro-

vide a transport system capable of engineering treatment, and in which the insulating material is inherently protected from surge phenomena which are probably the root cause of troubles with belts. The main contributions of the studies described have consisted in the development of high current (500 μA) charge transport systems, together with the development of satisfactory pulleys. With the introduction of bead chains by the Japanese it was clear that a possible system of induction charging had been developed that, despite some limitations, had considerable potential. Early attempts at Reading University followed the design of the Japanese chains, with rubber spacers and 10 mm diameter beads, but current limitation made these chains unsatisfactory. Attention was then turned to the "bicycle chain" developed at Wisconsin University, in which 10 mm beads were used, connected by insulating links. The current per chain was gradually increased to a maximum of 125 μA. The main concern, however, was the inherent instability of the system, and studies on this are described in detail. A limitation with this "pelletron" system is the current that can be carried by a single chain (100 μA for a 20 mm bead). For a large machine a maximum current of the order of 500 μA is required, requiring 100 mm beads, which are not practical. One alternative is the use of multiple chains, and another is development of the "laddertron", in which two bead chains on individual pulley systems are limited by metal strips. This system has several advantages, and is described in detail. A current of 550 μA was achieved on short circuit with the original system, i.e., with thin-wall beads. The laddertron system is at present undergoing final tests, and it appears that a stability of a few parts in 10^4 and a voltage of 1.2 MV on a 0.5 m. length can be achieved, and the machine should be capable of higher performance. (UK)

5684 (DNPL/NSF/R-5, pp 255-261) INDUCTION CHARGING OF FABRIC BELTS. Langsdorf, A. Jr. (Argonne National Lab., IL). 1973).

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

It was found that in an electrostatic generator used at Argonne from 1948 to 1968 the unshielded 3-ply spliced Fabreeka charging belt carried persistent patches of charge that typically caused ~2 kV terminal voltage modulations not compensated by the slow-acting corona-control voltage regulator. With the regulator charging system turned off a spontaneous contact current flowed to each pulley from the belt, which accumulated negative charge until limited by leakage. In dry room air, spontaneous charging was observed to give fields of about 2 kV/nm over the belt surface, sufficient to cause corona emission from lint anywhere on the belt or in its vicinity. In open air tests such corona accounted for about 6 μA of the leakage, and patchiness of charge was directly observed. Turning on the charging system could change, but not eliminate, these patches. That patches of charge were always present was suggested by observations of oscilloscope signal patterns that characteristically repeated once per belt revolution. Complete control of contact electrification of a fabric belt may not be possible, but the fluctuating contact charges can be replaced by a uniform induced charge; means of effecting this are described. The induction system has two particularly desirable characteristics. First, control of charging is equally easy at all gas pressures and independent of pressure except that corona voltage has to be kept roughly proportional to gas pressure. Secondly, the belt potentials and effective charging currents are more stable because each charging unit removes all charge inbound on the belt and replaces it by a definite outbound charge that is independent of the amount of inbound charge. With these new charging systems the modulations in terminal voltage could be kept as small as 400 V, and this limit apparently is not set by patches of charge. Belts lasted up to 1200 hr, whereas they previously failed at less than 600 hr. Some spark damage was observed. (UK)

5685 (DNPL/NSF/R-5, pp 283-291) CHARGE-STATE DISTRIBUTIONS OF METALLIC ION BEAMS FROM THE HARWELL TANDEM GENERATOR. Freeman, J. M.; Hooton, B. W.; Humphries, P. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The Harwell tandem generator is a vertical machine operating with up to 7 MV on the high voltage terminal, and accelerates a variety of light and heavy ions. Stripping at the center terminal is by C foils located on three wheels each carrying 30 foils. For some purposes, such as radiation damage studies, the accelerated multi-energy ion beams are used without magnetic analysis, and this led to a study of the unanalyzed beams, particularly with regard to their charge-state distributions and their accompanying contaminants. Measurements were made by focusing the accelerated beam through a 3 or 6 mm aperture on to a Au foil located in a target chamber above the analyzing magnet and detecting particles scattered from the foil into a previously calibrated Si detector placed 65 mm from the beam spot on the foil at an angle of 45° to the beam direction. The intensity with which particles were scattered from the foil was determined by the Rutherford differential cross section. An energy spectrum obtained with an accelerated oxygen beam and a terminal voltage of 4 MV is shown; also spectra obtained with an Fe ion beam at three different terminal voltages are shown. From the results the charge-state distribution corresponding to C foil stripping of an Fe beam at 4 MeV was obtained. Since the charge-state distributions were measured after the beam had been accelerated in the high energy tube they were not, however, necessarily a reliable measure of the values obtained immediately after stripping at the center terminal. Low energy contaminant components, accompanying the unanalyzed heavy ion beams, were evident in all the scattered particle spectra, and it was inferred that the contaminants were due to ionization of the residual gas in the high energy tube. The most likely contaminants were D, N, C and H, in atomic or molecular form. Evidence for molecular ions was found, and protons were observed with a lower analyzer field setting. (UK)

5686 (DNPL/NSF/R-5, pp 308-313) X-RAY SURVEY OF INCLINED FIELD TUBES CONDITIONING. Langevin, M.; Bretonneau, P.; Cieur, M. (Institut de Physique Nucleaire, Orsay, France). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The measurement of x-ray yield in a conditioning survey is stated to be of general use for axial field accelerating tubes, and localization of tube defects has been achieved by accurate measurements of end point bremsstrahlung energies. In inclined field tubes the reduced path of backstreaming electrons reduces the maximum energy and yield of x-ray emission, and in the case of inclined field tubes in a tandem machine it is rather difficult to find good criteria with which to monitor conditioning. Another point of interest is the localization of conditioning along the eight tube sections of an MP tandem. In order to obtain a general survey of the Orsay MP tube during conditioning, counters were suitably placed and x-ray levels were registered simultaneously with column current and tube vacuum values. It was found that x-ray emission travels along tube sections at different times, and is often accompanied by vacuum and column current variations, but can occur without any other indications. Two kinds of x-ray emission are observed. The first is continuous and the second slowly variable or discontinuous with bursts accompanied by instantaneous increases of tube pressure. Even with a fully conditioned tube, x-ray emission can be observed when the tube voltage is increased. It seems clear that an x-ray survey can be very useful during inclined field tube conditioning and can be used to avoid undesirable effects unobservable by conventional means. It also seems clear that pumping speed and instantaneous outgassing rate are important factors in tube breakdown. (UK)

5687 (DNPL/NSF/R-5, pp 352-366) EXPERIENCES WITH SUPPRESSED ACCELERATING TUBES. Hyder, H. R. McK.; Doucas, G. (Oxford Univ.). 1973.

From international conference on the technology of electroelastic accelerators; Daresbury, England (4 May 1973).

The Oxford University tandem accelerator which since start up in 1964 has run for over 43,000 hr is discussed. The machine employs inclined field accelerating tubes, the arrangement of which is shown. A magnetic section is employed at the entrance to tube 1 to suppress electrons without undue displacement of the low energy ion beam. A weak dipole field, normal to the beam axis, is produced by pairs of bar magnets mounted internally on the electrodes, and the direction of this dipole field rotates about the beam axis so that the field rotates first one turn clockwise and then one turn anti-clockwise. Secondary particles are subsequently suppressed by a radial electrostatic field formed by inclined electrodes. The vector defining this radial field also rotates about the beam axis. The radial momentum and displacement imparted to the ion beam and to secondary electrons by successive clockwise and anti-clockwise sections are shown diagrammatically. By varying the length of the sections and the rate of rotation of the vector it is possible to design the tubes so that the ion beam emerges essentially undeviated and with a small final displacement. By suitable electrode design, electrons can be prevented from travelling more than about 200 to 300 mm. The same is true of secondary ions in electrostatic sections, but in the magnetic sections the fields are too weak to trap even low energy ions. The effect of the suppression fields on the trajectories of beams in the low energy tubes, and singly and multiply charged beams in the high energy tubes, is shown. Several designs of electrodes that have been used are shown, and their performance described.

Details are given of the injector accelerator tubes and their performance. (UK)

5688 (HMI-B-137) ANNUAL REPORT FOR 1972: NUCLEAR PHYSICS. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jun 1973. 113p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

The annual report contains data on the activity of the nuclear physics section in HMI. The accelerator expansion and its approach to heavy-ion physics are reported. In addition, the work of the theoretical and experimental groups is described. (GE)

For title listings of selected papers see: 6430, 6440–6447, 6468, 6469, 6478, 6504, 6505, 6515, and 6540.

5689 (NP-19852) IPCR CYCLOTRON PROGRESS REPORT, 1972. Volume 6. (Institute of Physical and Chemical Research, Wako (Japan)). Dec 1972. 146p. Dep. NTIS (U. S. Sales Only) $9.50.

This volume contains recent information on the IPCR Cyclotron, informal reports, and abstracts of papers to be published at scientific meetings or in publications by staff members, guests, visitors. After brief introductory remarks information is presented under the following headings: machine operation, machine development, and accelerator physics, nuclear physics — scattering and reactions, nuclear physics — nuclear spectroscopy, nuclear instrumentation, radiochemistry, radiation chemistry and radiation biology, solid-state physics, radioisotope production and its applications, and radiation monitoring. Lists of publications, personnel, and outside users and their themes are also included. (RWR)

For titles of individual sections see: 4887, 4888, 4933, 5168, 5169, 5220, 5289, 5541, 6450, 6451, 6470, 6482, 6483, 6507, 6519–6521, 6542, 6549, 6550, 6570, and 6598.

5690 (ORO-3491-21) 1973 PROGRESS REPORT FOR THE EXPERIMENTAL STUDY OF THE STRUCTURE OF NUCLEI AND THE INTERACTIONS OF INTERMEDIATE ENERGY PARTICLES. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1973. Contract AT(40-1)-3491. 103p. Dep. NTIS $7.25.

Research on nuclear scattering and reactions, quasi-free scattering and reactions, and nuclear chemistry for the year ending August 31, 1973 is reported. Information on the cyclotron and instrumentation and work of outside users is also included. Experimental reports with significant amounts of data have been separately title listed. (RWR)

For title listing of selected papers see: 6433–6436, 6452–6456, 6486, 6487, 6525, 6551, 6552, 6572, and 6573.

5691 PROGRESS IN CONSTRUCTION OF THE SPS. Part I. Injection–Ejection, Magnets, and Power Supplies. CERN Cour.; 13: No. 11, 327-331(Nov 1973).

Construction progress on the CERN 300 GeV synchrotron is reported. The status of the injection system using the 28 GeV proton synchrotron, the beam extraction and transport system for the experimental areas, and the main ring magnets and power supplies is outlined. (WHK)

5692 LOW-ENERGY ELECTRON ACCELERATOR AS AN INTERDISCIPLINARY UNIVERSITY LABORATORY. Gozani, T. (Intelcom Rad Tech., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 57-58(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Auxiliaries and Components

5693 (DNPL/NSF/R-5, pp 121-133) HIGH GRADIENT STACK INVESTIGATIONS AT AWRE. Collins, L. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.); Howe, F. A.; Thorn, R. 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

After closure of the AWRE tandem generator as a nuclear physics experimental facility in 1968 it was suggested that it could become a useful test machine for assessing problems likely to be encountered in building a large high gradient tandem accelerator. At that time accelerator tube limitations were thought to be the most important problem, and the Science Research Council sponsored a programme to convert the machine into a tube testing facility capable of operating up to 6 MV at a gradient of 3.3 MV/m. Initial tube tests, however, were disappointing and their interpretation was complicated by numerous resistor and stack insulator failures. At this stage it was decided that effort should be redirected to obtain reliable stack and resistor operation, and since 1970 these aspects have been studied in detail. The work done is summarized. A description is given of initial stack construction, resistor development, work on insulators and spark gaps, and high voltage proving runs. Throughout the work there were indications that a critical limit existed beyond which serious insulator and resistor damage occurred. There were also indications of progressive increase in damage with use. Factors that are thought to have made the biggest contribution to the achievement of satisfactory operation at 6 MV with a gradient of 3.3 MV/m are stated. (UK)

5694 (DNPL/NSF/R-5, pp 134-146) SULPHUR HEXAFLUORIDE AS A GASEOUS INSULATOR FOR DC ACCELERATORS. Ashbaugh, P. G. (McMaster Univ., Hamilton, Ont.); Burn, N. 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

SF_6 gas is currently in use as an insulating gas in a number of large American and European dc accelerators, and its use will almost certainly continue with the upgrading of existing accelerators, such as the MP and FN tandems, the commissioning of the 14 UD Pelletron accelerator, and the development of the NSF 20/30 MV accelerator. An account is given of the electrical insulating properties of the gas, its physical properties, and safety aspects. (UK)

5695 (DNPL/NSF/R-5, pp 147-158) HIGH VOLTAGE TEST PROGRAMME AT DARESBURY FOR THE NSF ACCELERATOR. Aitken, T. W. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Some of the experimental work carried out at Daresbury into problems that arose during the design of this 20/30 MV tandem accelerator is described. Research is still continuing and it is hoped this will lead to further improvements in the design. The main topics of study described are (1) electrical properties of SF_6 insulating gas, (2) electrical strength of insulators and anomalous breakdown in thick insulators, (3) surface breakdown strength in SF_6 and field shaping using annular electrodes to protect against dc and fast transient voltages, (4) measurements of fast terminal discharges. (UK)

5696 (DNPL/NSF/R-5, pp 162-164) NEED FOR IMPROVED SPARK GAPS. Langsdorf, A. Jr. (Argonne National Lab., IL). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Large dc accelerators are inherently vulnerable to damage by electrical breakdown, which can prove very expensive, especially if it is irreversible damage inside the acceleration tube. Most of the damage is caused by breakdown initiated by transient overvoltages and can be avoided by installing protective spark gaps to limit the peak voltage gradients to safe values and to control the paths of heavy discharge currents. Although it has been standard practice to install spark gaps, little attention has been paid to design features ensuring their effectiveness. An elementary error is to design the discharge circuit so that it has unnecessary inductance, and another error is to have gaps that are too wide. Another problem is delay in ignition of a spark in the absence of free electrons that will trigger it; under transient conditions the longer the delay the higher the over-voltage before the spark ignites. One solution to this problem is to illuminate the electrodes with UV light, and ways of doing this are described. Yet another problem is concerned with the metal of which spark electrodes are made, including thin films on the surface of such metals. It has been stated that even in the presence of UV illumination twice the normal dc breakdown voltage is required to initiate the first spark in a train of sparks between Cu alloy electrodes that have had a resting period in an oxygen-containing atmosphere. If, however, the Cu electrode contains a suitably located insert of an Al alloy the initial over-voltage is very much reduced. (UK)

5697 (DNPL/NSF/R-5, pp 179-185) COMPARISON OF CALCULATED ELECTROSTATIC FIELD DISTRIBUTIONS IN TANDEM VAN DE GRAAFF ACCELERATORS. Rabinowitz, I. I. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The studies described were carried out to confirm the electrostatic design of the proposed NSF 20/30 MV tandem accelerator. Electrostatic field distributions at the terminal-stack junctions in HVEC EN, FN, MP, and TU tandems are given, as well as at the terminal-stack and intershield-stack junctions in the NSF tandem, for comparison purposes. Computational information is given (Pathfinder–Finale programme). A comparison of the maximum

field values in the tandems discussed is given in tabular form. The values taken for the potentials for the HVEC accelerators give roughly equal concentric cylinder geometry field strengths, with a higher value for the NSF. (UK)

5698 (DNPL/NSF/R-5, pp 265-274) BEHAVIOUR OF CARBON STRIPPER FOILS UNDER HEAVY ION BOMBARDMENT. Whitmell, D. S.; Armitage, B. H.; Porter, D. R.; Ferguson, A. T. G (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

In accelerating heavy ions in a tandem generator higher mean charge states are available from solid strippers than from gas strippers, and use of the former is desirable to maximize the production of high energy heavy ion beams. Whilst for light ions, such as H and He ions, foil life is adequate it becomes intolerably short when much heavier ions such as Fe ions are being accelerated. It has been found, however, that the lifetime of foils bombarded with 4 MeV Ni ions can be considerably increased by maintaining the foils at a high temperature. The first phase of a systematic study of the causes of this short life and of means of significantly increasing it is described. Most of the work was done using a beam of 4.8 MeV Ar ions from the Harwell 6 MeV Van de Graaff, but foils from the Harwell 14 MeV tandem accelerator bombarded with He, O and Fe ions were also studied by a variety of electron microscope techniques. C deposition and foil rupture were among matters studied. Among conclusions reached are that the lifetime of C stripper foils bombarded with heavy ions is limited both by hydrocarbon build up and splitting due to radiation damage, and that foil life may be extended by almost an order of magnitude by a combination of low beam density and heating. Future investigations are indicated. (UK)

5699 (DNPL/NSF/R-5, pp 275-279) SOME EXPERIENCES WITH FOIL STRIPPERS ON THE ERLANGEN EN-TANDEM. Kreische, W. (Univ., Erlangen, Ger.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The layout and operation of the machine at the University of Erlangen in Germany is described, and the stripping process is discussed. It was found that polarization of the beam of the machine increased by about a factor of two using foils instead of a gas stripper. A foil stripper was constructed in which no mechanical or electrical vacuum connections are made and the entire mechanism works in vacuum. The original assembly consists of two wheels each carrying up to 12 carbon foils, and has worked well over several years. Some improvements, however, are indicated, and in a later assembly up to 100 foils are placed on a chain and the remote control is modified. Some experiences with column resistors are also described. The machine runs up to 6.5 MV and to date only 10 resistors have been damaged. (UK)

5700 (DNPL/NSF/R-5, pp 314-321) MAGNETICALLY SUPPRESSED ACCELERATOR TUBE. Isoya, A. (Kyushu Univ., Fukuoka). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

It is stated that a magnetically suppressed 500 mm accelerator tube has been manufactured at Kyushu University for use with an existing Van de Graaff machine and has given a good performance for several years. The design of one unit of this tube is shown; the total tube consists of 10 units of similar structure. Permanent ring magnets are mounted in the middle and end positions of each unit. The field strength at the center of the ring is about 16 m T and is constant to within 6% over the 20 magnets used. The field directions of successive magnets are alternated to cancel deflection of the ion beam from the tube axis. The aperture of the electrode is made relatively large to obtain high pumping speed, and the electrode is constructed so as to prevent emission of secondary electrons from its edge and avoid electron loading. Electrodes in both sides of the ring magnets are provided with a guard ring on the periphery of the aperture to protect the insulator surface from bombardment by charged particles deflected by the magnets. The tube is protected from breakdown surges by a series of guard rings fitted to a periphery of each disk electrode. Around the circumference of the tube a spark gap of 3 mm is formed across every accelerating gap. With regard to performance, after several days of conditioning the threshold of electron loading rose to 7 MV. Discharges in the tube were very rare. By using an ion source with a carefully designed beam injection system a well-collimated proton beam of 26 μA at 5 MV could be obtained. The rate at which x-rays were produced was extremely low. The highest terminal voltage so far generated with a beam of several μA is 7.5 MV. The operating characteristics of an arrangement of the accelerator tube in conjunction with a pellet chain charge-carrying system are shown. Fabrication of an accelerator tube for use in the relatively high gradient field of the 5 m columns of the Kyusku 10 MV tandem accelerator has commenced, and design features are described. (UK)

5701 (DNPL/NSF/R-5, pp 344-351) INCLINED FIELD TUBE DESIGN AT THE 5 MV VAN de GRAAFF GENERATOR OF THE KFKI. Kostka, P.; Pasztor, E.; Buerger, G.; Kiralyhidi, L. (Central Research Inst. of Physics, Budapest). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Work carried out in connection with the installation of an inclined field acceleration tube in the 5 MV Van de Graaff machine at the Central Research Institute for Physics (KFKI), Budapest, in 1970 is described. This work was concerned mainly with the ion optical design and the tube manufacture. The tube has so far worked for about 9000 hr in the machine, and operationed experience is also described. (UK)

5702 (LBL-2136) MODERN CONTROL TECHNOLOGY WITH MODEL T COMPUTERS. Guggemos, J. R.; Rondeau, D. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 3p. (CONF-731204-1). Dep. NTIS $3.00.

From Digital Equipment Computers Users' Society symposium; San Francisco, California, USA (27 Dec 1973).

The evolution of the computer control system for the Bevatron is briefly described. The use of PDP-8 computers for control of the pulsed magnets, the magnet guide field, and the rf system and also for use as the human interface to the data stored on the disc by the control computers are described. The development of a PDP-8 system to control and monitor the new ion source, 50 MeV linac, 50 MeV transport line, and the Bevalac transfer line is mentioned. (WHK)

5703 (LNF-73/35) CALORIMETRIC MONITORING SYSTEM FOR LOW DUTY CYCLE BEAMS. Barbini, R.; Faini, S.; Guaraldo, C.; Schaerf, C.; Scrimaglio, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 13 Jun 1973. 10p. Dep. NTIS (U.S. Sales Only) $3.00.

A calorimetric monitoring system for the LNF-LEALE low energy pion beams is described. The apparatus measures the energy dissipated by the photons in the pion source with thermometric techniques. Numerical manipulation of the source temperature yields a relative but very stable monitor. (auth)

5704 (RL-73-63) TESTING OF ROLLING ELEMENT BEARINGS IN CRYOGENIC FLUIDS WITH APPLICATION TO THE ENERGY TRANSFER SYSTEM PROTOTYPE. Williams, J. A. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 46p. Dep. NTIS (U.S. Sales Only) $3.50.

Standard carbon-chrome steel bearings were tested without lubrication in cryogenic fluids under conditions comparable with the energy transfer prototype (magnet power supply system for a superconducting synchrotron), i.e. oscillation through 90° subject to constant axial and radial loads in excess of 500 kgm. Substitution of a plastic cage for the mild steel original improved the performance considerably such that friction coefficients were obtained around 0.02 to 0.03 whilst negligible wear was observed on the cage material after 1.5×10^6 cycles, this being estimated as the approximate life expectancy of the superconducting energy transfer prototype. (auth)

5705 (RL-73-77) PROGRESS IN THE DEVELOPMENT OF AN INTERACTING COMPUTER PROGRAM FOR MAGNETIC FIELD DESIGN AND ANALYSIS IN TWO AND THREE DIMENSIONS. Collie, C. J.; Diserens, N. J.; Newman, M. J.; Trowbridge, C. W. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jul 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The GFUN package of programs was first described at the Brookhaven Magnet Conference in September 1972. By a series of simple commands the user can draw in current or iron elements, and at the same time display a picture of the geometry. Further commands enable the fields to be computed at any point in space and the results to be displayed graphically. Work is now proceeding on new subroutines for the three-dimensional version. Attention is being given to the provision of a facility for describing the shapes of the ends of field windings. "Race Track" ends can now be handled by the program and other contours will be available in the near future. The program is being carefully checked by comparison with working magnets at the Rutherford Laboratory. (auth)

5706 (RL-73-105) DESIGN, CONSTRUCTION, AND TESTING OF THE SUPERCONDUCTING MAGNET AC4. Coupland, J. H. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

After a short introduction covering the purpose and general requirements for this prototype high field dipole magnet, the choice of design is discussed and described together with details of construction. The rest of the report is devoted to a comprehensive account of the extensive measurements taken under pulsed and d.c. operation. Although the thermal performance is largely as expected, the analysis of field integrals over the intended useful aperture shows that the uniformity is not yet sufficient for use in a super high energy proton synchrotron. However, despite iron saturation, the constancy in performance over the excitation range 0 to 5T is very encouraging. (Auth)

5707 BEAM CHARACTERIZATION AND MONITORING OF A HIGH INTENSITY PULSED ELECTRON SOURCE. Ling, C. C.; Weiss, H.; Epp, E. R. (Sloan-Kettering Inst. for Cancer Research, New York). Radiat. Res.; 56: No. 2, 307-319(Nov 1973).

A monitoring system using a ring-shaped Faraday cup has been developed to observe the pulse to pulse output variation of a field emission electron source currently used in cellular radiobiological experiments performed under ultrahigh dose rate conditions. The response of the monitoring system has been calibrated against those of a conventional Faraday cup and a calorimeter. It has been shown that the monitoring system closely tracks the variations in dose absorbed by cells irradiated by individual pulses. Characteristics of the electron beam pertaining to the radiobiological experimental setup such as the mean electron energy, the stopping power (dE/dx) and the equivalent beam energy were also investigated with special attention paid to the pulse to pulse variations in their values. It has been found that the mean electron energy (~480 keV) and the equivalent energy (~100 keV) increase, while the dE/dx value for beryllium (~3.4 MeV-cm^2/g) decreases with increasing beam fluence. (auth)

Ion Sources and Injection and Extraction Systems

5708 (DNPL/NSF/R-5, pp 402-413) POLARISED ION SOURCES FOR ELECTROSTATIC ACCELERATORS WITH SPECIAL REFERENCE TO THE UNITED KINGDOM NSF ACCELERATOR. England, J. B. A. (Univ. of Birmingham, Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Among matters discussed are: Basic principle of the operation of polarized ion sources; operational performance of polarized sources; transmission of polarized beams through the NSF; production of polarized beams of high intensity; possibility of acceleration of various polarized ions in the NSF. (UK)

5709 (RL-73-107) 70-MeV INJECTOR ALIGNMENT PROPOSALS. Part 1 Tank and Drift Tube Alignment. Lascelles, R. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 16p. Dep. NTIS (U.S. Sales Only) $3.00.

Proposals are presented for the alignment of the 70 MeV injector system. Separate diagrams show the spatial relation of the injector to NIMROD; the proposed alignment arrangements for tanks 1 to 4, and alternative arrangements; and the axial positioning of drift tubes in tanks 1 to 4. (UK)

5710 FEASIBILITY OF NUCLEAR POLARIZATION OF ^{3}He^{++} IONS BY ELECTRON-TRANSFER PROCESSES. Karban, O.; Oh, S.W.; Powell, W.B. (Department of Physics, University of Birmingham, England). Phys. Rev. Lett. 31: No. 2, 109-110 (9 July 1973).

Preliminary results are reported of an experiment confirming the feasibility of a Lamb-shift source of polarized ^{3}He^{++} ions. Such a source is under construction and will be used for the axial injection of ions into a cyclotron. (auth)

Ion Optics and Field Calculations

5711 (DNPL/NSF/R-5, pp 186-194) FIELD CALCULATIONS FOR A SINGLE ENDED VAN de GRAAFF WITH AN INTERSHIELD. Greenway, T. J. L. (Oxford Univ.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Reference is made to the University of Oxford single ended vertical injector Van de Graaff accelerator. This machine works at voltages up to 10 MV, and has a single intershield and a liner inside the tank for voltage stabilization. Since the machine was built, the Pathfinder computational program has been developed enabling plots of equipotentials in an electrostatic field to be made. Potentials are calculated in two dimensions by the method of successive over-relaxation, and a survey of the field around the electrodes has been made. A comparison is made with analytic solutions, and agreement found with the Pathfinder results, but a better description of the fields around hoops in the presence of an axial field is required. Very accurate results could be achieved with Pathfinder where the radii of curvature of the boundary surfaces are large compared with the mesh spacing. (UK)

5712 (DNPL/NSF/R-5, pp 195-197) CALCULATED FIELD DISTRIBUTIONS IN THE NSF TANDEM FACILITY. Eastham, D. A. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

It is stated that the highest static electric fields in a tandem accelerator occur near the junction of either the terminal and the stack or at the junction of the intershield and stack. The reason for this is the increased curvature orthogonal to the cylindrical curvature, caused by the hoop structure and the curved ends of the terminal or intershield. Calculations of the electric field were made for the NSF machine with a variety of different shapes for the curved section of the terminal and intershield, and an elliptical shape with major to minor axis ratio 2 : 1 was finally chosen. The computed electric field at the junction of the stack and terminal with the terminal at 30 MV is shown graphically; the peak electric field was found to be not more than 15% greater than the value on the center of the terminal. A promising way to reduce the electric field could be to adjust the geometry of the hoop structure so that stress multiplication is reduced. Calculations were made of the electric field on the surface of hoops both in the limit of no axial voltage gradient and when there is an axial field of 2 MV/m. The radial field was chosen as 10 MV/m without hoops. For FN hoops at the same potential, a reduction in the electric field was found when changing to oval hoops, but with an axial gradient of 2 MV/m the field was not reduced when changing to oval hoops. Hoops of circular cross section have been chosen for the NSF, giving a stress multiplication of 1.7 whilst maintaining an acceptable field strength between the hoops. (UK)

5713 EFFECT OF PLASMA IN AN ACCELERATING GAP ON CURRENT DENSITY IN A RELATIVISTIC ELECTRON BEAM. Nedoseev, S.L.; Smirnov, V.P.; Spektor, A.M.; Fil'kin, D.G. Sov. Phys.-Tech. Phys. 17: No. 12, 1961-1963 (June 1973).

It is shown experimentally that the introduction of plasma into the accelerating gap of a high-current relativistic electron accelerator makes it possible to increase the current density in the electron beam by a factor of 10–15 in comparison with the vacuum mode. The experiments are performed on the Neptune accelerator in which a shaping line provides a voltage of 0.7 MV and a current pulse of 20 kA lasting 40 nsec in a matched load. The plasma is produced in a separate source using a discharge along a dielectric surface and is introduced into the accelerating gap through an opening in the anode. The current density in the beam is $\approx$20 kA/cm^2, with an ion density $n_i = (2–3) \cdot 10^{12}$ cm^{-3}, providing there is partial neutralization of the space charge in the electron beam. (auth)

5714 STATIC FIELDS FOR PERIODIC ELECTROSTATIC FOCUSING OF ELECTRON BEAMS. Litvinenko, L.N.; Moroz, E.E.; Sal'nikova, L.P.; Shestopalov, V.P. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 17: No. 12, 1968-1972 (June 1973).

A rigorous method is proposed for calculating the spatial distribution of the potential of a spatially periodic electrostatic field in the gap between two planar strip lattices and for periodic structures with cylindrical symmetry. A computer is used to calculate and plot equipotential lines and the variation of the potential in the gap between the electrodes. It is shown that the values of the potential in a periodic structure found by rigorously solving the problem can differ appreciably (by up to 20%) from the values found from approximate solutions in which the rigorous boundary conditions are replaced by sinusoidal distributions of the potential in the planes of the lattice strips. (auth)

5715 INTERACTION OF A DENSE CRITICAL-ENERGY BEAM WITH ACCELERATOR RESONATORS. Balbekov, V.I.; Pashkov, P.T. Sov. Phys.-Tech. Phys. 17: No. 12, 2006-2008 (June 1973).

The transition through the critical energy in a proton synchrotron with high beam intensity is considered. Unlike earlier papers, the present paper includes the longitudinal Coulomb field of the bunches and the voltage the bunches induce in the resonators. It is shown that in cases of interest in practice these effects can affect the modulation of the envelope of the bunch which arises after the critical energy is traversed. Results obtained by solving the phase equation on a computer are given in the form of curves covering a wide range of accelerator parameters. (auth)

5716 DISTRIBUTION OF FIELDS AND EFFECTIVE LENGTHS OF SEVERAL TYPES OF SEXTUPOLE LENSES. Baranova, L. A.

Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 12, 2130-2133(Dec 1972).

Translated from Radiotekh. Elektron.; 17: No. 12, 2642-2643 (Dec 1972).

Expressions are given for the effective lengths and the distribution of the potential in the vicinity of the optical axis for electrostatic and electromagnetic sextupole lenses. The dependence of the effective length on the mechanical length is graphed. (WHK)

5717 SUPERPOSED MULTIPOLAR LENSES. Baranova, L. A.; Yavor, S. Ya. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 12, 2128-2130(Dec 1972).

Translated from Radiotekh. Elektron.; 17: No. 12, 2639-2641 (Dec 1972).

The transformation of images by a system of multipolar electrostatic and electromagnetic lenses is examined in the first approximation. (WHK)

Storage Rings

5718 (BNL-18318) ISABELLE: BROOKHAVEN INTERSECTING STORAGE ACCELERATORS. Blewett, J. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 11p. (CONF-731115-2). Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

The status of the ISABELLE project is briefly reviewed, and the design parameters are outlined including the lattice configuration, magnets, magnet power supply, injection, rf system, vacuum system, experimental areas and options. (WHK)

5719 EXACT LONGITUDINAL EQUILIBRIUM DISTRIBUTION OF STORED ELECTRONS IN THE PRESENCE OF SELF-FIELDS. Haissinski, J. (Paris Univ., Orsay, France). Nuovo Cim., 18B: No. 1, 72-82(11 Nov 1973).

The longitudinal equilibrium distribution of electrons stored in a ring is computed in the general case of a nonlinear accelerating field. From this is derived an equation which gives the exact longitudinal density in the presence of longitudinal fields generated by the circulating particles. A method for solving numerically this equation is given and the exact solution is compared to the lowest-approximation solution when self-fields are proportional to the derivative of the bunch density. (auth)

Experimental Facilities

5720 (BNL-18248) PRELIMINARY NEUTRON FOIL DOSIMETRY CHARACTERIZATION OF THE BLIP NEUTRON FACILITY. Parkin, D. M.; Dudey, N. D.; Heinrich, R. R.; Fluss, M. J. (Brookhaven National Lab., Upton, N.Y. (USA)). 29 Aug 1973. 38p. Dep. NTIS $4.00.

The Brookhaven Linac Isotope Producer (BLIP) produces neutrons from 200 MeV proton bombardment of a transparent (relative to 200 MeV protons) Be target. Threshold foil dosimetry techniques were utilized to characterize the BLIP neutron spectra which includes neutrons with energies greater than 15 MeV. Some operational characteristics of spallation neutron sources were also determined. The derived BLIP neutron spectrum has a hard component (neutrons between 6 to 12 MeV which peaks at 8 to 9 MeV) and a soft component characteristic of neutron scattering. Between 10 and 30% of the neutrons have energies below 0.25 MeV and less than 0.1% of the neutrons have energy in excess of 15 MeV. The derived neutron flux is $8.0 \pm 3 \times 10^3$ n/cm^2 μC. (auth)

5721 DEGENERATION OF TRITIUM TARGET. Hiraoka, E.; Furuta, J.; Fujishiro, M.; Kanazawa, T.; Ohnishi, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 86-93(1972).

Tritium targets are used for neutron sources in low voltage accelerators. The damage of tritium targets and its contamination observed during the experiment are reported. The contamination of tritium is caused by titanium fragments generated during the accelerator operation, and the tritium gas contamination in the accelerator tube and vacuum pump oil reported so far might be due to titanium fragments. (auth)

5722 THICK LITHIUM METAL TARGET FOR FAST NEUTRON PRODUCTION. Kawade, K.; Yamamoto, H.; Amemiya, S.; Hiei, A.; Katoh, T. (Nagoya Univ., Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 507-510(Aug 1973).

High flux fast neutrons were produced by (d,n) reactions in a lithium metal target. A thick lithium layer for the target was prepared by a simple method of melt-coating on a copper plate. The fast neutron (>9 MeV) flux at a distance of 6 mm from the target was $(9.0 \pm 1.6) \times 10^6$ n/cm^2·sec·μA with use of a 2.0 MeV deuteron beam. A flux of 2.7×10^9 n/cm^2·sec was obtained by bombarding the target with the deuteron beam of 300 μA. (auth)

5723 NEW 10 MeV LINEAR ACCELERATOR FOR RADIATION THERAPY. Karzmark, C. J.; Fessenden, P.; Hughes, D. B. (Stanford Univ., CA). Radiology; 109: No. 3, 721-722(Dec 1973).

A prototype linear accelerator treatment unit capable of providing two different electron treatment modalities in addition to 6 MV megavoltage x-ray treatments is described. This unit offers 5 MeV large-field superficial total-body treatment at a SSD of 3.5 m as well as electron treatment at 10 MeV or lower energies for small fields at a SSD of 100 cm. (auth)

5724 COLLIMATOR WITH SHED COVER FOR FORMING THE BEAM OF ELECTRONS OF THE B5M-25 BETATRON. Dmitrov, G. P.; Skoropad, Yu. D.; Zudin, Yu. V. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 18: No. 9, 69-74(Sep 1973). (In Russian).

The results of investigations of dose fields of Betatron B5M-25 electrons, made up by a factory collimator system with draw-tubes and a collimator with a shed cover are presented. Unlike the factory collimator system, the collimator with a shed cover makes it possible to get typical curves of the depth distribution of the dose and smoothly change the size of irradiation field and the distance. (auth)

5725 NEW FACILITY FOR ACTIVATION ANALYSIS WITH THICK TARGET, 110-MeV ELECTRON BREMSSTRAHLUNG. Ricci, E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 87-88(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5726 ALPHA-PARTICLE EXCITATION USING CYCLOTRONS. Cahill, T. A.; Flocchini, R. G.; Fenney, P. J. (Univ. of California, Davis). Trans. Amer. Nucl. Soc.; 17: 102(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5727 PRODUCTION AND USE OF NEGATIVE PIONS IN RADIOTHERAPY. Raju, M. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 115(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5728 PRODUCTION AND USE OF PROTONS AND ALPHAS IN RADIATION THERAPY. Koehler, A. M. (Harvard Univ., Cambridge, MA). Trans. Amer. Nucl. Soc.; 17: 115-116(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5729 PRODUCTION AND USE OF CYCLOTRON-PRODUCED NEUTRONS IN RADIOTHERAPY. Almond, P. R. (M. D. Anderson Hospital, Houston, TX). Trans. Amer. Nucl. Soc.; 17: 116(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5730 USE OF NEW ACCELERATOR SOURCES IN RADIATION THERAPY. Brennan, J. T. (Hospital of the Univ. of Pennsylvania, Philadelphia). Trans. Amer. Nucl. Soc.; 17: 116(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

5731 RADIOLOGICAL RESEARCH WITH HEAVY ACCELERATED IONS. Tobias, C. A. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 17: 117(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

5732 PHYSICS IN PERSPECTIVE. Volume II, Part B. The Interfaces. Washington, DC; National Academy of Sciences (1973). 725p. $13.50.

The topics covered are astrophysics and relativity, earth and planetary physics, physics in chemistry and biology, instrumentation, education, and the dissemination and use of the information of physics. (JFP)

Cosmic Radiation

Refer also to abstracts 5210, 5241, 5821, 5951, 6148, 6149, 6284, 6285, and 6547.

5733 ABSOLUTE VERTICAL INTENSITY OF MUONS NEAR SEA LEVEL. Flint, R.W.; Hicks, R.B.; Standil, S. (Department of Physics, The University of Manitoba, Winnipeg, Manitoba, Canada). Phys. Rev. D 8: No. 5, 1300-1304 (1 Sept 1973).

Current interest in an absolute measurement of the vertical intensity of muons stimulated the present research. A novel method for the classification of events, and in particular the separation of muons from the soft component, has enabled the determination of a set of relatively precise and reliable measurements. The results so obtained are somewhat lower than the few other recently reported measurements. (auth)

5734 ENERGY SPECTRUM OF NUCLEI WITH $Z \geq 60$ AS EVIDENCE FOR A NEW SOURCE OF COSMIC RAYS. Osborne, W.Z.; Pinsky, L.S. (Physics Department, University of Houston, Houston, Texas, 77004); Shirk, E.K.; Price, P.B.; Kobetch, E.J.; Eandi, R.D. Phys. Rev. Lett. 31: No. 2, 127-130 (9 July 1973).

We have found the energy spectrum of cosmic rays with $Z \geq 60$ to be much steeper in the neighborhood of 1 GeV/amu than measured spectra of less massive cosmic rays. The data analysis includes effects due to solar modulation. This low-energy enhancement of high-Z primaries implies sources which either are strongly enriched in very heavy elements or have a Z-dependent acceleration mechanism. (auth)

5735 CALCULATIONS OF NEUTRON FLUX SPECTRA INDUCED IN THE EARTH'S ATMOSPHERE BY GALACTIC COSMIC RAYS. Armstrong, T.W.; Chandler, K.C.; Barish, J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37830). J. Geophys. Res. 78: No. 16, 2715-2726 (1 June 1973).

Calculations have been carried out to determine the neutron flux induced in the earth's atmosphere by galactic protons and alpha particles at solar minimum for a geomagnetic latitude of 42° N. Neutron flux spectra in the energy range $\approx 10^{-9}$ to $\approx 10^{5}$ Mev at various depths in the atmosphere were calculated by using Monte Carlo and discrete ordinates methods, and various comparisons with experimental data are presented. The magnitude and shape of the calculated neutron leakage spectrum at the particular latitude considered support the theory that the cosmic ray albedo neutron decay (Crand) mechanism is the source of the protons trapped in the inner radiation belt. (auth)

5736 TIME DEPENDENT WORLDWIDE DISTRIBUTION OF ATMOSPHERIC NEUTRONS AND THEIR PRODUCTS 1. FAST NEUTRON OBSERVATIONS. Merker, M.; Light, E.S.; Verschell, H.J.; Mendell, R.B.; Korff, S.A. (Department of Physics, New York University, New York, New York, 10453). J. Geophys. Res. 78: No. 16, 2727-2740 (1 June 1973).

The time dependent worldwide distribution of atmospheric fast neutrons has been determined in balloon and aircraft measurements from 1964 to 1971. The 1- to 10-Mev neutron spectrum was measured with a phoswich detector employing seven channels of pulse height analysis. Solar modulation effects were greatest near the high-latitude transition maximum, where the flux varied by more than a factor of 2 from solar minimum to the deepest Forbush decrease. Near solar maximum and during Forbush decreases the relation between the neutron flux in the upper atmosphere and the counting rate of the Deep River neutron monitor deviated from a single-valued function. The differential neutron spectrum between 1 and 10 Mev can be represented, within the resolution of the detector, by a power law $N(E) = AE^{-n}$, where $n = 1.17_{-0.20}^{+0.12}$ near the transition maximum, $n = 1.08_{-0.20}^{+0.13}$ at 3- to 5-g/cm² atmospheric depth, and n at sea level is larger than these values and dependent on terrain. The spectral index remains the same to ± 0.1 over the solar cycle at fast neutron energies. The fast neutron data are self-consistent to $\pm 7\%$ from 2 to 300 g/cm² over the range of cutoff rigidity and solar cycle variations. The characteristics of the fast neutrons as outlined here serve as a basis for checking a Monte Carlo calculation of the entire neutron distribution and its products. (auth)

5737 TIME DEPENDENT WORLDWIDE DISTRIBUTION OF ATMOSPHERIC NEUTRONS AND OF THEIR PRODUCTS 2. CALCULATION. Light, E.S.; Merker, M.; Verschell, H.J.; Mendell, R.B.; Korff, S.A. (Department of Physics, New York University, New York, New York, 10453). J. Geophys. Res. 78: No. 16, 2741-2762 (1 June 1973).

We have calculated the global distribution of atmospheric neutrons and their products by a Monte Carlo simulation of nucleon transport in the internuclear cascade followed by neutron transport below 19 Mev. First, we present the results generated by monoenergetic primary protons and alpha particles entering the top of the atmosphere. Second, the kernels derived from the monoenergetic cases are used to determine the spatial and energy distributions of neutrons and their products from the protons and alpha particles in the cosmic radiation; solar modulation effects are included. The calculation is compared, in the 1- to 10-Mev region, with the results of our fast neutron experiment; the agreement is within the uncertainties of the primary spectrum and of the experimental results over most of the atmosphere. The calculation is then normalized to the experiment in the fast neutron region. The results of the normalized calculation include the steady state neutron spectrum, the neutron production rates, the radiocarbon production rates, the neutron leakage rates from the top of the atmosphere, and the production rates of other nuclides. The normalized calculation reproduces experimentally observed slow neutron densities and the observed neutron flux and spectrum above 1 kev, and it predicts features of the atmospheric neutron morphology not yet observed. The points of agreement and divergence with earlier calculations are discussed, including the radiocarbon production rates and the neutron leakage rates during solar cycle 20, which is near the mean of the last 10 solar cycles. (auth)

5738 TIME DEPENDENT WORLDWIDE DISTRIBUTION OF ATMOSPHERIC NEUTRONS AND OF THEIR PRODUCTS 3. NEUTRONS FROM SOLAR PROTONS. Mendell, R.B.; Verschell, H.J.; Merker, M.; Light, E.S.; Korff, S.A. (Department of Physics, New York University, New York, New York, 10453). J. Geophys. Res. 78: No. 16, 2763-2778 (1 June 1973).

During solar particle events from 1968 to 1971 we observed increases in the fast neutron flux at high latitude and at 55- to 75-g/cm² atmospheric depth. The increases correlated with the variations in the solar proton fluxes; the neutron yield per incident proton, above threshold, increased by a factor of 100 with increasing hardness of the proton spectrum. Within a factor of 2 the neutron specific yield fell on a smooth curve versus the spectral parameter P_0, where the values of P_0 were based on the SPME (solar proton monitor experiment) data from Explorer 34 and 41. The neutron yield from solar particle events was calculated from a Monte Carlo simulation of neutron production and transport in the atmosphere. We compare the observed fast neutron flux with that calculated using the solar proton spectra reported at the times of the measurements; the causes for variation among the reported proton spectra and between the calculated and the observed fast neutron flux are discussed. The calculation reproduced the results of experiments by others with moderated slow neutron counters in and above the atmosphere. We calculate that the contribution of solar particle fluxes to the production rates of neutrons, to the production rates of radiocarbon, and to the leakage rates of neutrons from the top of the atmosphere are 2-3 orders of magnitude below the galactic cosmic ray contribution during solar cycle 20. (auth)

5739 CALCULATED COSMIC RAY NEUTRON MONITOR RESPONSE TO SOLAR MODULATION OF GALACTIC COSMIC RAYS. O'Brien, K.; Burke, G.d.P. (Health and Safety Laboratory, U.S. Atomic Energy Commission, New York, New York, 10014). J. Geophys. Res. 78: No. 16, 3013-3019 (1 June 1973).

The response of the NM-64 cosmic ray monitors at Deep River, Alert, Goose Bay, and Inuvik to solar modulation of galactic cosmic rays has been calculated using the force field approximation to transport through the interplanetary medium. Count rates (to within 2%) normalized to the rates observed in mid-1965 are given in terms of the energy lost per unit charge (the modulating potential) of galactic cosmic rays reaching the earth's orbit. The purpose of this calculation is to allow the inference of the primary spectrum at the earth's orbit simply from a knowledge of the neutron monitor count rates. (auth)

5740 SOLAR MODULATION OF GALACTIC COSMIC RAYS 3. IMPLICATIONS OF THE COMPTON-GETTING COEFFICIENT. Fisk, L.A. (Laboratory for High Energy Astrophysics, Goddard Space Flight Center, Greenbelt, Maryland, 20771); Forman, M.A.; Axford, W.I. J. Geophys. Res. 78: No. 7, 995-1006 (1 Mar 1973).

It is useful to express spectra of modulated galactic cosmic rays in terms of the Compton-Getting coefficient C. This parameter can reveal the energy range over which the force field approximation is valid and the range where convection effects dominate over those of diffusion. A value of C near zero over an extended low-energy range (according to recent observations this is the situation for protons) implies that the

radial gradient at low energies cannot be large. This small gradient may imply, in turn, that the diffusion coefficient increases beyond 1 AU less rapidly than if it were proportional to heliocentric radial distance and/or that there is essentially no scattering for a sizeable distance from the sun to earth. The behavior of C with rigidity (or energy) is discussed in terms of the omnidirectional distribution function f_0. Contours of constant f_0 in the heliocentric distance versus rigidity plane are useful for illustrating the mean rigidity loss experienced by cosmic rays in the interplanetary medium. (auth)

5741 COSMIC RAY SPECTRUM AT ENERGIES ABOVE 10^{17} eV. Edge, D. M.; Evans, A. O.; Garmston, H. J.; Reid, R. J. O.; Watson, A. A.; Wilson, J. G.; Wray, A. M. (Univ. of Leeds, Eng.). J. Phys., A (London); 6: No. 10, 1612-1634(Oct 1973).

A determination of the total energy spectrum of primary cosmic ray particles for the energy range from 3×10^{17} eV up to about 10^{19} eV is reported. This is based on a ground parameter, given by measurements in deep water-Cherenkov detectors, chosen to have minimum sensitivity both to the nature of the primary particles (charge spectrum) and to details of nuclear interactions involved in shower development (introduced into the treatment as a series of models covering what are thought to be important possible features of interactions at extreme energies). It is accordingly largely free from uncertainties about both the charge spectrum and details of shower development. The primary total energy integral spectrum: $I(E_p) = (4.5 \pm 0.5)10^{-10} (E_p/10^{17})^{-2.11 \pm 0.03}$ $m^{-2}s^{-1}sr^{-1}$ (E_p in eV), is shown to hold between 3×10^{17} eV and 10^{19} eV, and the evidence is consistent with a continuation of this form up to about 10^{20} eV. (auth)

5742 ANALYSIS OF COSMIC RAY DATA IN TERMS OF MODELS OF HIGH ENERGY INTERACTIONS. Wdowczyk J.; Wolfendale, A. W. (Univ., Lodz, Poland). J. Phys., A (London); 6: No. 10, 1594-1611(Oct 1973).

A variety of cosmic-ray data are analyzed from the point of view of determining the effective multiplicity of charged pions produced in the interactions of the primary cosmic rays with air nuclei. If intranuclear cascading is small and the primaries are mainly protons then the multiplicity is higher than that given by the "scaling" hypothesis, which has been shown to have a measure of applicability at ISR energies. Agreement with scaling can be restored if the mean mass of the primary particles increases dramatically above a few times 10^{14} eV but such a change seems very unlikely both in view of various extensive air shower phenomena and because of astrophysical considerations. (auth)

5743 COSMIC RAYS. Pomerantz, M. A. Van Nostrand Reinhold Momentum Books. New York, Van Nostrand Reinhold Company (1971). 192p. $3.95.

Topics covered include historical introduction, collisions of cosmic rays with matter, experimental methods, propagation through the Earth's magnetic field and atmosphere, galactic cosmic rays, cosmic-ray intensity variations, solar cosmic rays, and the origin of cosmic rays. (WDM)

5744 MEASUREMENT OF GEOMAGNETIC CUTOFF RIGIDITIES AND PARTICLE FLUXES BELOW GEOMAGNETIC CUTOFF NEAR PALESTINE, TEXAS. Pennypacker, C. R.; Smoot, G. F.; Buffington, A.; Muller, R. A.; Smith, L. H. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 10, 1515-1527(1 Apr 1973).

A high-statistics magnetic spectrometer measurement of the geomagnetic cutoff rigidity and related effects at Palestine, Texas is reported. The effective cutoffs observed are in agreement with computer-calculated cutoffs. Measured spectra of albedo and atmospheric secondary particles that come below geomagnetic cutoff are also reported. (auth)

5745 MUON CONTENT IN HORIZONTAL AIR SHOWERS. Hochart, J. P. (CNRS, Verrieres-le-Buisson, France). J. Phys., A (London); 6: No. 10, L148-L150(Oct 1973).

The muon content in horizontal air showers is calculated for various assumptions about the origin of these showers. It is shown that the experimentally observed relatively high muon densities are not in clear contradiction with a conventional origin of the horizontal showers. (auth)

5746 (LAFE-140) COSMIC NEUTRON FLUX AND GAMMA-RAYS VARIATION AS A FUNCTION OF LATITUDE AND ALTITUDE. Martin, I. M.; Albernhe, F.; Vedrene, G. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1970. 30p. (In French). INIS.

The measurements of fast neutron spectra from 1 to 15 MeV and of gamma rays from 0.7 to 4.5 MeV were carried out in balloons at 10, 46, and 62°N geomagnetic latitudes. The observed spectra followed a law of the form $dN/dE = AE^{-\gamma}$ with $\gamma = 1.4 \pm 0.1$ for the neutrons and $\gamma = 1.5 \pm 0.1$ for the gamma rays. It was observed at the time of the measurements that the exponent (γ) remains constant as a function of the latitude and the altitude between 120 and 4 g/cm^2. The value of the coefficient A is a function of the latitude and of the atmospheric pressure. At 4 g/cm^2 a ratio of 9 exists for the neutrons between the measured fluxes at 10 and 46°N while for the gamma rays the ratio is 3. This difference, as well as the analysis of the attenuation length and the position of the Pfotzer maximum for the latitudes, shows that the gamma rays are for the largest part dependent on the photoelectronic component that arises from the decay of π^0 mesons, produced at the top of the atmosphere by primary cosmic radiation. (tr-auth)

5747 ELECTRON ENERGY SPECTRUM IN THE COSMIC RADIATION. Apparao, K. M. V. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 7: No. 17, 865-866(25 Aug 1973).

The differential energy spectrum of electrons can be represented by a power law of the form $N(E) = AE^{-\gamma}$, where E is the kinetic energy and A and γ are constants. For the energy ranges 5 to 300 GeV, 100 MeV to 2 GeV, and 1 to 50 MeV γ is 2.5, 1.5, and 3.5, respectively. The spectrum beyond 100 MeV is considered and an explanation for its shape is sought. (WDM)

5748 SOLAR-CYCLE DEPENDENCE OF GALACTIC COSMIC RAY FLUX. I. Coronal Indices. Parker, G. D. (Univ. of Denver). Solar Phys.; 31: No. 1, 259-269(Jul 1973).

The coronal green line intensity is inappropriate for correlation studies of galactic cosmic ray variations. Being a non-monotonic function of coronal temperature, the green line intensity is a good index of neither coronal temperature nor solar wind speed. A more appropriate measure of coronal activity is the intensity of the electron corona. Two-dimensional observations of the K-corona trace changes in coronal morphology during the solar cycle. An index based on four years of K-coronal measurements made in Hawaii shows that activity in the lower corona is not better correlated than sunspot number with long-term modulation. Correlation analysis defines the time lag of modulation much too poorly to permit its use in estimating the size of the heliosphere. (auth)

5749 CALCULATIONS OF THE PRODUCTION OF RADIOACTIVE ISOTOPES IN THE EARTH'S ATMOSPHERE BY GALACTIC COSMIC RAYS. O'Brien, K. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 17: 576-577(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Stars

Refer also to abstracts 5830, 5906, 5956, 6142, 6196, and 6623.

5750 FINE STRUCTURE IN NGC 7027. Balick, B.; Bignell, C. (National Radio Astronomy Observatory Green Bank, West Virginia); Terzian, Y. Astrophys. J. Lett. 182: No. 3, L117-L120 (15 June 1973).

Synthesis observations at 8085 MHz with spatial resolution of ≈2′ show the distribution of radio emission from the nebula NGC 7027 to be complex. Main components separated by ≈5′ are superposed on a broader background of radius less than ≈7′. There is a general, but not detailed, agreement between radio and optical features of the nebula. Consequences of the radio and optical brightness distributions and radio optical depth are discussed. (auth)

5751 OBSERVATION OF 9.0-MICRON LINE EMISSION FROM Ar III in NGC 7027 AND NGC 6572. Geballe, T.R. (Department of Physics, University of California, Berkeley, 94720); Rank, D.M. Astrophys. J. Lett. 182: No. 3, L113-L116 (15 June 1973).

The fine-structure line of Ar iii at 1112 cm^{-1} has been observed in the planetary nebulae NGC 7027 and NGC 6572. The measured line intensities are compared with theoretical estimates for these nebulae. (auth)

5752 HELIUM ATOM STEADY-STATE EQUATIONS IN MATRIX FORM. Borodina, E.G. (Central Astronomical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 1, 75-80 (July 1973).

A system of steady-state equations in matrix form was solved for atomic helium. The gas opacity for resonance radiation and the effect of higher levels, usually neglected, were taken into account in computing the level population. The matrix elements of A and C were determined [Eqs. (24), (27), and (30)]. The inverse matrix C^{-1}, required to determine the Menzel parameters b_i, was found by Shreider's method as a product of transposed diagonal and triangular matrices. (auth)

5753 INTERNAL STRUCTURE OF ROTATING BARYON CONFIGURATIONS. Arutyunyan, G.G.; Sedrakyan, D.M.;

Chubaryan, E.V. (Erevan University). Sov. Astron.–AJ 17: No. 1, 38-41 (July 1973).

The basic parameters describing the internal structure of rotating configurations are calculated on the basis of Einstein's gravitation theory. The influence of rotation on the absolute gravitational mass defect is determined. (auth)

5754 STABILITY AND RADIAL PULSATIONS OF ROTATING NEUTRON STARS. Vartanyan, Y.L.; Ovsepyan, A.V.; Adzhyan, G.S. (Erevan University). Sov. Astron.–AJ 17: No. 1, 30-37 (July 1973).

Radial pulsations in cold rotating neutron stars near the state of onset of instability are analyzed by the energy method. Second-order general-relativity effects of the rotation are taken into account. The expansion of the energy with respect to the relativistic terms converges very well. The integral parameters and radial-pulsation frequency are calculated for various equilibrium configurations. For stable neutron stars, rotation alters the pulsation period only very slightly. The gravitational mass defect for rotating configurations is calculated, as well as the effects of integration between neutrons in an actual neutron gas, according to Saakyan and Vartanyan's model. (auth)

5755 CHEMICAL COMPOSITION OF GLOBULAR-CLUSTER STARS AND THE FORM OF THE HORIZONTAL BRANCH. Mironov, A.V. (High-Altitude Observatory, Shternberg Astronomical Institute, Alma-Ata). Sov. Astron.–AJ 17: No. 1, 16-23 (July 1973).

The dependence of the form of the horizontal branch in globular clusters on the amount of mass loss during the evolutionary process and on the helium abundance Y in the stellar envelopes is discussed. The mass-loss parameters are adopted in accordance with Iben and Rood's theory. Christy's and Iben and Huchra's theoretical results for the properties of pulsating RR Lyr stars provide estimates of Y. These values range from 0.07 to 0.59 and are correlated with the helium abundance determined independently by the method of Iben et al. Hartwick's Y classes do not appear to represent the actual helium abundance in the stars investigated. A correlation is found between Y and the richness of a globular cluster in W Vir variables. Two types of globular cluster are discovered to exist, differing in the relation between the form of their horizontal branch and chemical composition. A relation is also established between the most probable amount of mass loss by cluster stars and their chemical composition. This relation differs for the two types of cluster that have been identified. (auth)

5756 FORMATION OF CORONAL LINES IN THE SPECTRA OF NOVAE. II. Gorbatskii, V.G. (Leningrad University). Sov. Astron.–AJ 17: No. 1, 11-15 (July 1973).

The time dependence of coronal-line intensities in nova spectra is calculated and compared with the observations. The thermal-relaxation process behind the shock front in the circumstellar envelope is analyzed in detail, taking into account the ionization and excitation of helium. This procedure yields an estimate for the mass loss by recurrent novae between outbursts. (auth)

5757 NATURE OF THE OPTICAL VARIABILITY OF HZ HERCULIS (Her X-1) AND BD+34°3815 (Cyg X-1). Lyutyi, V.M.; Syunyaev, R.A.; Cherepashchuk, A.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 1, 1-6 (July 1973).

Photographic and photoelectric light curves of the HZ Her binary system indicate that a strong reflection effect ($\simeq 1^m.5$) results from reprocessing of the x rays from the Her X-1 component in the photosphere of the visible component. In the BD+34°3815 system the optical variability is caused primarily by the ellipsoidality of the visible component. The variability amplitude depends on the oblateness of the star and the orbit inclination i. For components with a given mass ratio the oblateness can be determined from the theory of stars filling their critical Roche surface. The photoelectric data then yield sin i, setting a lower limit $M_x > 7.8\ M_\odot$ on the mass of the x-ray component Cyg X-1. (auth)

5758 INFLUENCE OF SCATTERING BY PLASMA OSCILLATIONS ON THE SPECTRUM OF A SEMITRANSPARENT PLASMA. Tomozov, V.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 1, 140-142 (July 1973).

A discussion is given of the influence of photon scattering by high-frequency Langmuir oscillations upon the spectrum of the radiation emerging from an optically semitransparent plasma. The plasma turbulence is assumed to be excited by streams of fast particles; under astrophysical circumstances this situation can arise in a supernova outburst or when a neutron star accretes the surrounding material. From the characteristic bends in the Rayleigh-Jeans region of the spectrum one can, in principle, establish the parameters of the radiating plasma and the Langmuir turbulization power. (auth)

5759 SPECKLE INTERFEROMETRY: COLOR-DEPENDENT LIMB DARKENING EVIDENCED ON ALPHA ORIONIS AND OMICRON CETI. Bonneau, D.; Labeyrie, A. (Observatoire de Paris, Meudon, France). Astrophys. J.; 181: No. 1, L1-L4 (1 Apr 1973).

Speckle-interferometry images of α Orionis and o Ceti, recorded with a television system on the 200-inch telescope, were studied visually as a preliminary reduction procedure. Both stellar disks have a limb-darkened profile which is appreciably wider in blue than in yellow and red light, suggesting a contribution of scattering phenomena in chromospheric opacity. (auth)

5760 NATURE OF THE INFRARED POINT SOURCE IN THE ORION NEBULA. Becklin, E. E. (California Inst. of Tech., Pasadena); Neugebauer, G.; Wynn-Williams, C. G. Astrophys. J.; 182: No. 1, L7-L9(15 May 1973).

New photometric observations of the BN infrared source in the Orion Nebula eliminate the possibility that it is simply a highly reddened star, and undermine the conclusion that there are 80 mag of visual extinction to the source. It is suggested that there is a generic relationship between it and the infrared source IRS 5 in the H II region W3. (auth)

5761 PRESENCE OF A SCATTERED CONTINUUM IN THE PLANETARY NEBULA BD + 30°3639. Persson, S. E.; Frogel, J. A. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 182: No. 1, 177-181(15 May 1973).

A measurement of the strength of Hβ relative to that of the nebular continuum in the planetary nebula BD + 30°3639 is reported. The equivalent width of Hβ alone, exclusive of the central star, is found to be 1000 ± 200 Å, while the theoretical value at T_e = 10,000°K is ~2000 Å. It seems likely that the excess continuum flux is due to starlight that is scattered by particles within the nebula. The scattering optical depth of these particles probably lies between 0.05 and 0.10, depending on T_e. (auth)

5762 ATLAS OF SUPERNOVA SPECTRA. Greenstein, J. L. (California Inst. of Tech., Pasadena); Minkowski, R. Astrophys. J.; 182: No. 1, 225-243(15 May 1973).

A selection of supernova spectra is given. Most could be calibrated for relative intensities of spectral features. Only a brief attempt is made to interpret these spectra. The atlas should serve as a guide to the observation and interpretation of photographic and spectrophotometric studies of the evolution, for example, of the current bright Type I supernova in NGC 5253. The last section presents some uncalibrated image-tube spectra for the latter. Peculiar types of supernovae are included, with some details of the evolution of spectra of Types I, II, III, and V. Rapid changes and the P Cygni character of lines in Types II, III, and V are displayed. The figures provide data for identification, wavelengths and velocities, and the relative importance of emission and absorption. (auth)

5763 MOTION OF FOURTEEN STARS IN THE ORION NEBULA CLUSTER. Vaerewyck, E. G.; Beardsley, W. R. (Univ. of Pittsburgh). Astrophys. J.; 182: No. 1, 121-127 (15 May 1973).

Photographs of the Orion Nebula Cluster obtained with the Thaw Refractor of the Allegheny Observatory were utilized to determine relative motions among a number of bright blue stars near the center of the association Id Ori. No cluster expansion was detected for these stars. Results indicate instead that these massive stars may be moving inward toward the center. An abrupt change in scale that occurred in 1944 was allowed for, but did not affect the results. (auth)

5764 SEARCH FOR NEUTRAL HYDROGEN IN THE GALACTIC CLUSTER NGC 2287. Poeppel, W. G. L. (Instituto Argentino de Radioastronomia, Buenos Aires); Vieira, E. R. Rev. Brasil. Fis.; 2: No. 2, 59-66(Aug 1972).

Observations were made in the direction of the galactic cluster NGC 2287 and its neighborhood with the radiotelescope at Parque Pereyra Iraola. The results do not give a definite conclusion about the presence of neutral hydrogen in the cluster because of the complexity of the region. An upper limit to neutral hydrogen associated with this cluster and within 1° of it is found to be 600 $M_\odot$. (auth)

5765 NEW BINARY SYSTEMS. Sokolova, V. A. (Central Astronomical Observatory, Pulkova, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 1051-1052(1973).

Translated from Astron. Zh.; 49: No. 6, 1326-1327(1972).

Three double stars, which are very likely physical binary systems, were identified from their common proper motions. The absolute and relative positions are tabulated. The distance of these binaries is ≈30–60 pc; their orbital periods are ≈22,000, 6000, and 4000 yr. (auth)

5766 MODEL FOR AXISYMMETRIC CLUSTERS OF STARS WITH UNIFORM MASS. Bagin, V. M. Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 1003-1007(1973).

Translated from Astron. Zh.; 49: No. 6, 1249-1257(1972).

A model is developed for star clusters with axial symmetry and member stars of uniform mass, where, in general, the average circular velocity is different from zero. There are two possible types of continuous families of solutions. Particular cases of the first family include elliptical and ring clusters; for elliptical clusters the limiting case is Schuster's spherically symmetric solution. The second family exhibits paired centers of star concentration; spindle-shaped clusters represent a special case. All these cases have actually been observed. For both types of solution a distribution function is derived for the number of stars with respect to coordinates and velocities; in the special case of a spherically symmetric solution it coincides with the Eddington distribution. (auth)

5767 COSMOLOGICAL HYPOTHESIS FOR THE ORIGIN OF GLOBULAR CLUSTERS. Ruzmaikina, T. V. (Moscow Physical Technical Inst.). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 991-996(1973).

Translated from Astron. Zh.; 49: No. 6, 1229-1237(1972).

Peebles and Dicke's hypothesis for the cosmological origin of globular clusters is applied to consider the possible fragmentation of primordial clouds into stars by thermal instability for a wide range of initial conditions. Thermal instability would cause the central part of a cloud to disintegrate; it would cease to contract because of the passage of weak shock waves heating the material to 2000 to 5000°K. If the central cloud temperature is lower, a star with $M \approx 10^2 M_\odot$ will be generated. Globular protoclusters will become isolated from the background Friedmann expansion when $z > 10$, and the most probable epoch for such events would be $z \approx 40$. (auth)

5768 COMPARISON OF THE ANGULAR EXPANSIONS OF PLANETARY NEBULAE MEASURED AT PULKOVO AND AT HARVARD. Orlova, O. N. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 949-951(1973).

Translated from Astron. Zh.; 49: No. 6, 1164-1167(1972).

The angular expansions derived at Pulkovo for the planetary nebulae NGC 6720, 6853, and 7662 exceed the values obtained at Harvard by the Lillers. There is evidence that the Lillers' measurements contain a systematic error due to the change from a silvered to an aluminized mirror in the Lick reflector for the second-epoch plates. (auth)

5769 SOUTHERN PECULIAR STARS WITH ABNORMAL SPECTRA. Brandi, E. (Observatorio Astronomico de La Plata); Claria, J. J. Astron. Astrophys., Suppl. Ser.; 12: No. 1, 79-83(Oct 1973).

The spectral classification of 42 southern metallic-line and peculiar A-type stars is described. (auth)

5770 PERIOD VARIATIONS OF FOURTEEN ECLIPSING BINARIES WITH POSSIBLE LIGHT-TIME EFFECT. Frieboes-Conde, H.; Herczeg, T. (Hamburger Sternwarte, Hamburg). Astron. Astrophys., Suppl. Ser.; 12: No. 1, 1-78(Oct 1973).

For fourteen eclipsing binaries available data is discussed with regard to a possible light-time effect. The period changes do not reveal any definitely recognizable triple systems with light-time orbit. Nevertheless, seven of the binary systems should be kept on the list of possible candidates. SV Cam, TV Cas, and U Oph, where periodic variations of the O-C values reported earlier could be confirmed. U CrB, Z Dra, RT Per, and X Tri, where possible light-time variations may be superposed on sudden changes of the period. In addition to these systems, periodic representation of the times of minimum are not impossible in the case of XZ And, AD And, and SW Cyg. Estimates of the mass of hypothetical third companions in the system AD And and SW Cyg led, however, to unacceptably high values. Concerning the variables ZZ Cas, ZZ Cyg, RV Lyr, and RW Tau, representation of the O-C values by periodic curves seems to be impossible. Previous interpretations based on light-time effect should be rejected. For all objects where light-time interpretation of the O-C curve for the epochs of minima is to be ruled out, indications show sudden period variations, period jumps. Changes of this type also offer an alternative interpretation of the observed period variations in the case of U CrB, SW Cyg, and X Tri. The $\Delta P/P$ ratio is always of the order of 10^{-6}. (auth)

5771 PHOTOMETRY OF NOVA CEPHEI 1971. Kohoutek, L.; Klawitter, P. (Hamburg Observatory). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 347-363(Sep 1973).

The preliminary light-curve in the UBV-system, constructed in the form m(log t), shows three linear parts differing from each other in the rate of decline. Small light variations during the slow early decline and oscillations up to 1 mag in the transition stage have been observed. The date of maximum, July 6, 1971 has been stated with a maximum brightness $V_{max} = B_{max} = U_{max} \simeq 7.0$ mag. The nova is classified as a fast one according to the derived parameters log t_2 and log t_3, giving $M_{max}(B) = -8.0$ mag and $M_{max}(V) = -7.7$ mag. The photometric distance of the nova, r = 3.8 kpc, could be estimated. A 17 mag-star with irregular variations between 16.6 and 18.1 mag has been identified as the pre-nova. (auth)

5772 PHOTOELECTRIC OBSERVATIONS OF THE Ap STAR HD 98088. Maitzen, H. M. (Univ., Bochum, Ger.). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 327-334(Sep 1973).

Photoelectric observations of HD 98088 in 11 filters (UBV, uvby, H-Gamma-Broad, H-Beta-Broad, and two intermediate band filters at 5030 and 5240 Å) revealed the following features of this Ap star: (1) A marked light variation is visible only in U, v, B. (2) In B there are two maxima and minima, the maxima being slightly different; the depth of the secondary minimum is less than half the primary. (3) The primary minimum is very close to superior conjunction of this binary where the variation of the Sr and Eu lines exhibits a primary maximum. The secondary minimum of the light curve is related to the secondary maximum of these line strengths. (4) The intensity distribution relative to the comparison star HD 98853 shows two depressions: a deep one (up to 25%) around 4120 Å, where the maximum light variation occurs, and a smaller one (10%) at 5240 Å. Both phenomena have already been found in the Eu-Cr-objects HD 221568 and HD 125248. (5) From the b-y value one can deduce a spectral type of about A4. This is in far better agreement with the H-Gamma spectral type of A2.6V derived by Abt et al. (1968) than the classification of gF0p by Wilson and Joy (1950). (auth)

5773 VERY RED STARS AND PLANETARY NEBULAE. Cesco, C. U.; Gibson, J. (Observatorio Austral, Barreal, Argentina). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 335-337(Sep 1973).

Lists of red stars and planetary nebulae discovered on plates taken with a Ross lens corrected for blue light are presented. The recognition of such objects as anomalous images by simple visual examination of the plates is shown to be a useful technique for the detection of such objects. Possible mechanisms for the production of these anomalous images are discussed. (auth)

5774 NATURE OF A NEBULOUS OBJECT IN THE CHAMAELEON T ASSOCIATION. Feast, M. W.; Glass, I. S. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 35P-38P(1973).

Spectroscopy and infrared photometry of Cha 16 indicate that it probably belongs to the R Mon class and extends to lower luminosities the range in which these objects have been found. (auth)

5775 DETECTION OF M15 AT 10.2 μ. MacGregor, A. D.; Phillips, J. P.; Selby, M. J. (Imperial Coll. of Science and Tech., London). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 31P-33P (1973).

The detection of infrared emission at 10.2 μ from the central regions of the metal deficient globular cluster, M15, is reported, and some possible origins are examined. (auth)

5776 BINARY SYSTEM 57 CYGNI. Apsidal Motion and Effects of Spectral Line Blending. Hilditch, R. W. (Dominion Astrophysical Observatory, Victoria, B. C.). Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 101-110(1973).

Spectroscopic observations of 57 Cygni obtained at discrete intervals during the past 60 yr are discussed. An apsidal period of (203 ± 4) yr is derived indicating a mean central condensation parameter $\bar{k} = (0.0060 \pm 0.0035)$. A study of a new series of spectrograms with fine-grained emulsion failed to reveal any of the weak absorption lines, arising from highly excited ions, which were detected and measured for radial velocity by Ovenden (Mon. Not. R. astr. Soc.; 126: 77(1963)). Effects of blending of spectral lines on their measured positions are discussed and it is proposed that the radial-velocity anomalies determined by Ovenden are the consequence of this spectral line blending. (auth)

5777 PHOTOMETRIC STUDY OF THE OPEN CLUSTER IC 2157. Grubissich, C. (Univ., Basel). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 287-290(Sep 1973).

Three-color photometry of this stellar group in the RGU-system on plates of the 48" Palomar-Schmidt leads to a true distance modulus of 11.41 mag (1900 pc). The earliest spectral type is b4. (auth)

5778 CALCULATION OF FLUX CONSTANT LINE-BLANKETED MODEL ATMOSPHERES FOR SOLAR TYPE STARS. Bell, R. A. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 197-210(1973).

Two computer programs have been used to compute flux constant model atmospheres, which include the effects of convection as well as line blanketing, for solar type stars. One program computes a model atmosphere and then calculates the integrated

radiative flux and convective flux as a function of optical depth. After applying a line-blanketing correction to the fluxes, temperature corrections are calculated and a new model atmosphere computed. A second program computes the line blocking of a model atmosphere as a function of optical depth. The line-blocking data, expressed as a function of the radiative flux computed without allowance for line absorption, is used by the model atmosphere program to allow for line absorption effects. This method of computing line-blanketed model atmospheres, the flux-fraction method, does not make the opacity correlation assumption that is inherent in the giant-line method. Model atmospheres have been computed for the Sun, a metal deficient star ([A/H] = −0.6) and Groombridge 1830 and the colors of these models are discussed. The models do predict the observed variation of ultraviolet excess, δ(U-B), with metal abundance. (auth)

5779 STUDY OF OB-STARS IN THE LARGE MAGELLANIC CLOUD BY UBV PHOTOMETRY. Nandy, K.; Dodd, R. J.; Wolstencroft, R. D. (Royal Observatory, Edinburgh). Mon Notic. Roy. Astron. Soc.; 164: No. 3, 43P-48P(1973).

Preliminary results of a survey of OB stars in a region of approximately 0.75 square degrees centered on R.A. (1950) 5h 40m, Dec. (1950) −70° in the Large Magellanic Cloud are described. The UBV plates taken with the Curtis Schmidt telescope at Cerro Tololo were measured by GALAXY to a limiting magnitude V= 17.0m. By measuring all the stars in a small area of the plate and by studying the (U−B, B−V) diagram for each magnitude interval, it is shown that the OB stars in the LMC can be identified. Two-color and color-magnitude diagrams, and surface distribution of probable early type members in this region of the LMC are presented. Within the errors of observation no significant reddening has been detected. (auth)

5780 IONIZATION STRUCTURE OF PLANETARY NEBULAE. X. The Contribution of Charge Exchange and Optically Thick Condensations to [01] Radiation. Williams, R. E. [University Coll., London]. Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 111-119(1973).

Recent theoretical and observational investigations have demonstrated the importance of condensations in enhancing the line emission from ions of low ionization potential in planetary nebulae. However, model nebulae which include high-density filaments, and which satisfactorily explain the observed fluxes of the [O II] and [N II] lines in the nebulae, have been unable to account for the observed flux of [O I] λ 6300. We suggest that this problem is due to the neglect of charge-exchange reactions in normal photoionization models of nebulae. Calculations are presented which show that hydrogen−oxygen charge transfer $H^+ + O^0 \rightleftharpoons H^0 + O^+$ is an important process which governs the ionization equilibrium of neutral oxygen, and that it acts to increase the emission of [O I] significantly. (auth)

5781 PHOTOELECTRIC UBV PHOTOMETRY OF STARS IN TEN SELECTED AREAS. Penston, M. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 121-132(1973).

Photoelectric UBV observations are given for a total of 128 stars in the Kapteyn Selected Areas 3, 5, 83, 85, 89, 91, 93, 95, 97, and 99. SA 97 lies within 8 degrees of the Orion Nebula and there is evidence that suggests that some stars observed may be members of the Ori I Association. (auth)

5782 PHOTOELECTRIC UBV OBSERVATIONS MADE ON THE PALOMAR 20-INCH TELESCOPE. Penston, M. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 133-154(1973).

This paper presents the results of 762 UBV observations of 203 stars made between 1969 December and 1971 September mostly on the 20-in. telescope on Palomar Mountain. Nearly all stars are brighter than V ~ 13.0m. The results are given under the program headings as follows: 1. A stars in the North Galactic Cap. Ninety-two stars classified as A0 or A2 for which radial velocity observations are available. 2. Interesting blue stars. Mostly hot stars observed spectroscopically by Greenstein. 3. Twenty-three F or G dwarfs from the Bright Star Catalogue. 4. Four stars from the Catalogue of Nearby Stars. Previous photometry of these stars had placed them among the giants in the (U−B)/(B−V) diagram although their spectra and parallaxes suggested that they were dwarfs. 5. Stars proposed as faint standards by Peterson. 6. Variable stars. Miscellaneous observations of six RR Lyrae variables (SW And, XX And, XZ Dra, TT Lyn, AV Peg, and CG Peg) and one star suspected of being nonvariable (AT Her). 7. Miscellaneous stars. (auth)

5783 STELLAR GROUP BASEL 11 IN TAURUS. Grubissich, C. (Univ., Basel). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 283-286(Sep 1973).

RGU-color photometry was carried out on the 48″ Palomar-Schmidt plates. The highly reddened stars probably form a real group at a distance of 1.5 kpc. (auth)

5784 LINEAR OPERATORS AND TRANSFER OF RADIATION WITH SPHERICAL SYMMETRY. Wang, A. P. (Arizona State Univ., Tempe). J. Math. Phys. (N. Y.); 14: No. 7, 855-862(Jul 1973).

This paper is concerned with the construction of linear-operator equations for transfer of radiation taking place on a spherical shell. A complete set of equations is obtained for inhomogeneous, anisotropically scattering media with internal or external illumination and with an arbitrary reflecting core. In application, linear-operator equations are reduced to a class of familiar functional equations. The general result provides answers to a set of well-known problems in astrophysics. (auth)

5785 INTRODUCTION TO THE PHYSICS OF STELLAR INTERIORS. Kourganoff, V. Astrophysics and Space Science Library, Volume 34. Boston; D. Reidel Publishing Company (1973). 126p. $18.00.

Translation of Introduction a la Physique des Interieurs Stellaries by Janet Rountree Lesh.

Topics covered include: general considerations concerning the energy radiated by stars; mechanical equilibrium (the equilibrium between the gravitational force per unit volume and the gradient of the total pressure); determination of the internal structure by the density distribution; energy equilibrium and nuclear reactions; and evolutionary models (the actual determination of structure). (WDM)

5786 INFRARED SPECTRUM OF TWO CARBON STARS FROM 4000 TO 6700 cm^{-1}. Thompson, R. I. (Univ. of Arizona, Tucson); Johnson, H. L.; Forbes, F. F.; Steinmetz, D. L. Publ. Astron. Soc. Pac.; 85: No. 507, 643-652(Oct 1973).

The infrared spectra of Y CVn and U Hya from 4000 to 6700 cm^{-1} are presented. Preliminary identifications of molecular and atomic features were made. The bearing of these observations on observed C^{12}/C^{13} ratios is discussed. The spectra are corrected for atmospheric extinction to a reference altitude of 14 km. (auth)

5787 CALCIUM CHLORIDE IN THE SPECTRA OF CARBON EMISSION-LINE STARS. Rybski, P. M. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 85: No. 507, 653-658(Oct 1973).

A program of low-resolution observations of carbon stars in the range 4300 to 6700 Å has resulted in the observation of CaCl molecular absorption of varying strength in three stars known to exhibit Hα in emission. These observations show that CaCl absorptions may appear in spectra of stars of this type at any of several phases rather than strictly near minimum light. Variations in the strengths of other molecular features occurred with the sudden appearance of CaCl, and all the stars reddened noticeably at this time. The period during which CaCl was strong was surprisingly short for one of the stars, increasing the difficulty of any subsequent detailed analysis of the CaCl phenomenon. (auth)

5788 RADIAL VELOCITY OF RGO 153, A CARBON STAR IN THE FIELD OF OMEGA CENTAURI. Smith, M. G. (Cerro Tololo Inter-American Observatory, La Serena, Chile); Wing, R. F. Publ. Astron. Soc. Pac.; 85: No. 507, 659-660(Oct 1973).

The radial velocity of RGO 153, one of three carbon stars that have been found in the field of the globular cluster ω Cen, differs by more than 250 km sec^{-1} from the mean cluster velocity, indicating that the star is not a physical member of the cluster. (auth)

5789 UBV OBSERVATIONS OF HELIUM STARS. Landolt, A. U. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 507, 661-665(Oct 1973).

UBV photoelectric observations of most of the known helium stars seem to indicate that at least some of these stars are variable at optical wavelengths with total amplitudes of ~ 0.1m. (auth)

5790 DEPENDENCE OF MICROTURBULENCE OF ABSOLUTE F-VALUES. Andersen, P. H. (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 85: No. 507, 666-669(Oct 1973).

A study of 51 main-sequence A to G stars shows that microturbulent velocities derived using the Kiel absolute f-values for Fe I are generally smaller than those determined with the Corliss and Warner f-values. Also, in this spectral range excitation temperatures for Fe I come out to be higher by about −0.2 in θ. (auth)

5791 VY SCULPTORIS, A NEW RAPID BLUE VARIABLE. Burrell, J. F.; Mould, J. R. Publ. Astron. Soc. Pac.; 85: No. 507, 627-631(Oct 1973).

Rapid variations with an underlying 500-second periodicity are reported for VY Scl, a blue star at the south galactic pole. Broad

absorption lines are visible beneath the bright line spectrum. It is suggested that the star is a dwarf nova, not the R CrB-type star previously proposed. (auth)

5792 PHOTOMETRIC AND SPECTROGRAPHIC OBSERVATIONS OF HR 6684. McNamara, D. H.; Bills, B. G. (Brigham Young Univ., Provo, UT). Publ. Astron. Soc. Pac.; 85: No. 507, 632-636(Oct 1973).

One hundred and two differential magnitude measurements of HR 6684 were obtained on two nights. The star varied in light in a period of 0.139890d with a total range $\simeq 0.030$m. uvbyβ photometry was used to derive reddening-free indices $(b-y)_0 = -0.106$, $(c_1)_0 = 0.098$, $(m_1)_0 = 0.089$). The β index indicated $M_v = -2.6$. Nine spectrograms secured through one light cycle indicated that the radial velocity is either constant or has a very small amplitude ($\lesssim 5$ km sec^{-1}). In all other respects the star resembles the broad-line group of β Cep (or β CMa) variables. (auth)

5793 VISUAL AND INFRARED PHOTOMETRY OF RY SAGITTARII NEAR THE PHASE OF DEEP MINIMUM. Lee, T. A. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 85: No. 507, 637-640(Oct 1973).

Photometric measures near the deep minimum phase are presented for the R CrB-type star, RY Sgr. While the visual brightness was some 4 magnitudes fainter than observed in 1969, the infrared flux levels ($\lambda \geq 3.4\ \mu$) remain essentially unchanged. (auth)

5794 SEARCH FOR DIFFUSE BANDS IN CIRCUMSTELLAR SHELLS. II. Snow, T. P. Jr. (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 85: No. 507, 590-592(Oct 1973).

Spectra of several stars thought to be embedded in circumstellar dust shells are examined and evidence for circumstellar diffuse band absorption is sought. Most of the objects are thought to be undergoing pre-main-sequence contraction, although a few are probably evolved objects undergoing mass loss. No evidence for circumstellar diffuse band formation is found in spite of the presence of substantial circumstellar extinction in some cases. (auth)

5795 N III EMISSION LINES IN THE Of STARS. Mihalas, D. (High Altitude Observatory, Boulder, CO). Publ. Astron. Soc. Pac.; 85: No. 507, 593-598(Oct 1973).

Recent work has lead to an improved understanding of the physical mechanisms which produce the N III emission lines in Of stars. The present status of the problem is briefly reviewed in this paper. (auth)

5796 EMISSION PROFILE OF Hα IN THE SPECTRUM OF β LYRAE. Batten, A. H.; Sahade, J. (Instituto de Astronomia y Fisica del Espacio, Buenos Aires). Publ. Astron. Soc. Pac.; 85: No. 507, 599-605(Oct 1973).

The emission profile of Hα above the continuum in the spectrum of β Lyr appears to consist of two components, a "broad" one of total width about 1000 km sec^{-1} and central intensity approximately equal to that of the neighboring continuum at midprimary eclipse, and a "narrow" one of total width between 600 km sec^{-1} and 700 km sec^{-1} and central intensity several times that of the broad component. The total intensity of the emission remains approximately constant over time intervals comparable to the orbital period, the large apparent changes being mainly the results of the changing intensity of the stellar continua during the eclipses. From one year to another, however, real changes in the mean emission intensity may occur. The center of the narrow component shows little or no velocity shift throughout the orbital cycle. The center of the broad component shows shifts that could be interpreted as being opposite in phase to those shown by the primary (B8 absorption) spectrum. Preliminary measures of Hβ and Hγ suggest that the Balmer decrement of the narrow component is appreciably steeper than that of the broad component. A tentative explanation of these facts is offered. The narrow component of the emission is believed to arise in a shell or ring surrounding the whole system, while the broad component comes from an envelope around the still unobserved secondary star. The "satellite" lines seen in the spectrum during primary eclipse are explained as absorption lines produced in the envelope, rather than as a direct result of absorption by gaseous streams. Actually there is only one gaseous stream in the system flowing from the B8 component toward its companion. (auth)

5797 UBV OBSERVATIONS OF XX CAMELOPARDALIS AND RHO CASSIOPEIAE. Landolt, A. U. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 507, 606-607 (Oct 1973).

UBV photoelectric observations taken over a five-year period are presented for the R CrB-like variable XX Cam and for the supergiant ρ Cas. (auth)

5798 MONOCHROMATOR COLOR INDICES OF DELTA SCUTI AND RHO PUPPIS. Trodahl, H. J.; Sullivan, D. J.; Beaglehole, D. (Victoria Univ., Wellington, New Zealand). Publ. Astron. Soc. Pac.; 85: No. 507, 608-617(Oct 1973).

A scanning monochromator whose dispersive element was a circular interference filter was used to study the color variations of the variable stars δ Sct and ρ Pup. The spectra were measured between 3700 and 7300 Å with a resolution of about 200 Å and were recorded approximately every 10 minutes over several complete cycles of each star. The color changes found for δ Sct were rather larger than have been reported previously, and indicated temperature changes of up to 400°K. Measurements for ρ Pup, which does not show the beating common in δ Sct stars, are consistent with those reported previously. (auth)

5799 PERIOD STUDY FOR UZ CYGNI, VW CYGNI, AND RX GEMINORUM. Hall, D. S.; Woolley, K. S. (Vanderbilt Univ., Nashville). Publ. Astron. Soc. Pac.; 85: No. 507, 618-624(Oct 1973).

All available times of minimum for UZ Cyg, VW Cyg, and RX Gem were collected and analyzed. The period of VW Cyg decreased suddenly around JD 2417400 by $\Delta P/P = -2.9 \times 10^{-5}$, then remained constant for 1550 cycles, then began increasing steadily. The period of RX Gem decreased suddenly around JD 2427600 by $\Delta P/P = -4.1 \times 10^{-5}$, then began increasing steadily. The O−C curve of UZ Cyg was represented with a straight line, that of VW Cyg with two straight lines and a parabola and that of RX Gem with one straight line and a parabola. The last two curves are discussed in the context of the period change model of Biermann and Hall; comparison of the period decrease with the subsequent rate of increase implies that angular momentum is being stored as rotation faster than turbulence can put it back into the orbit. (auth)

5800 UBV OBSERVATIONS OF LONG-PERIOD VARIABLE STARS. VIII. Landolt, A. U. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 507, 625-626(Oct 1973).

Photoelectric observations of 33 long-period and 2 R CrB-type variable stars are presented on the UBV photometric system. (auth)

5801 LUMINOSITY AND VELOCITY DISTRIBUTION OF HIGH-LUMINOSITY RED STARS. III. Old-Disk-Population Giants. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 85: No. 507, 542-563(Oct 1973).

The domain in the (U,V) plane of old-disk-population stars is defined by a sample of F- and G-type stars brighter than visual magnitude 6.5 for which luminosities are available from intermediate-band photometry. The majority of these old-disk stars avoid the domain of the young-disk population in the (U,V) plane except for (1) several objects with V near −17 km sec^{-1} and (2) a half dozen possible members of a solar group. The sample of stars used to define the old-disk population is confined to distances less than 100 parsecs from the Sun and those with V near −17 km sec^{-1} may represent several generations of the objects formed in what is now the solar neighborhood and which keep returning to this neighborhood because they are isoperiodic (V near −17 km sec^{-1}) with the local standard of rest. The half dozen possible members of a solar group indicate an evolutionary age of some 5×10^9 years. In addition to some of the previously recognized stellar groups in the old-disk population (e.g. Wolf 630 and ζ Her), a new group with U = +40 to +50 km sec^{-1} and V = −36 km sec^{-1} is also discussed. The sample of red giants: ($V_E < 5.0$m and $(R-D)_0 > +0.42$M) contains eight probable members of the halo population of which five are members of the Arcturus group. Possible structure in the old-disk-population giant sequence is discussed on the basis of published narrow-band indices, and the luminosity functions of the old- and the young-disk-population red giants are compared. (auth)

5802 INTERNAL MOTIONS IN ORION OB1a: ALTERNATIVES TO RAPID EXPANSION. Steffey, P. C. (Univ. of California, Santa Monica). Publ. Astron. Soc. Pac.; 85: No. 507, 520-523 (Oct 1973).

A brief critique of published evidence for rapid expansion of OB associations is presented followed by results of a detailed study of the internal motions in Orion OB1a, which show that a dominant stream velocity component combined with a member distance increase across the group can produce the apparent expansion discovered by Lesh (1968b). (auth)

5803 EMISSION-LINE OBJECT FOUND IN THE ORION NEBULA. Gull, T. R. (Kitt Peak National Observatory, Tucson, AZ); Goad, L.; Chiu, H. Y.; Moran, S. P.; Hobbs, R. W. Publ. Astron. Soc. Pac.; 85: No. 507, 526-527(Oct 1973).

A small, low-temperature, high-density object has been found superimposed upon the Orion nebula. The observed spectrum suggests it is a Herbig−Haro object. (auth)

5804 SPECTROPHOTOMETRY OF THE ORION NEBULA. Simpson, J. P. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 85: No. 507, 479-492(Oct 1973).

Observations of line and continuum strengths were made in six regions in the Orion Nebula. From the observations, electron temperatures, electron densities, and chemical abundances were derived. A model for the Orion Nebula was computed that agreed with the optical and radio observations of the Nebula. Scattering and absorption by dust were added to the model and the predicted scattered continuum was compared to the observed continuum. (auth)

5805 LUMINOUS STARS IN THE CORES OF H II REGIONS. Johnson, H. M. (Lockheed Missiles and Space Co., Palo Alto, CA). Publ. Astron. Soc. Pac.; 85: No. 507, 586-589(Oct 1973).

A criterion is discussed for the identification of stars that ionize gas and heat dust in the denser parts of H II regions, and it is applied to the Luminous Stars in the Southern Milky Way. Various data of 51 candidate stars, 35 apparently new ones, are tabulated in correspondence with data of the nebular sources. Some cases of apparently accidental projection of foreground stars and aspects of failure to find stars in some H II cores are discussed. (auth)

5806 PREDETONATION LIFETIME AND MASS OF SUPERNOVAE FROM DENSITY-WAVE THEORY OF GALAXIES. Moore, E. (New Mexico Inst. of Mining and Tech., Socorro). Publ. Astron. Soc. Pac.; 85: No. 507, 564-567(Oct 1973).

Stars in a normal spiral galaxy are formed in a shock front on the inner edge of a spiral arm according to nonlinear density-wave theory, then drift across the arm as they age. Over half of the 19 supernovae measured occur at the innermost edge of a spiral arm, implying a lifetime of less than five million years and mass greater than 35 solar masses. (auth)

5807 FREQUENCY OF FLARES OF STAR HARO 18 IN THE PLEIADES. Parsamyan, E. S. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 297-298 (1971).

Translated from Astrofizika; 7: No. 3, 507-509(1971).

Haro was the first to call attention to the high frequency of flares of star Haro 18. In the summer of 1970 all photographs of the Pleiades, obtained on the 21- and 40-inch Schmidt telescopes, were again examined together with Haro to find recurrent flares among the isolated group of flare stars. The author's latest observations, carried out during September 1970, were added to the data thus obtained. The effective time of observations on the 40-inch telescope was equal to 73 h in photographic light and 17 h in ultraviolet light, and on the 21-inch telescope, 176 h in photographic light. (auth)

5808 NUCLEOSYNTHESIS OF ELEMENTS: S-PROCESS. Shorin, V. S.; Gribunin, V. M.; Kononov, V. N.; Sidorova, I. I. (Power Physics Inst., Obninsk, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 286-293(1971).

Translated from Astrofizika; 7: No. 3, 489-500(1971).

The S-process of stellar nucleosynthesis, treated as sequential "slow" capture of neutrons by iron nuclei, was simulated with an analog computer. The solutions obtained go a long way in explaining the observed correlation between the abundance of nuclides in the solar system and the neutron radiative capture cross sections, if it is assumed that the distribution function of neutron exposures $\rho(\tau)$ is of the form: $\rho(\tau) = G_1\exp(-\tau/\tau_1) + G_2\exp(-\tau/\tau_2)$. The role of nuclear isomeric states excited in the neutron capture process is discussed. (auth)

5809 ROTATING WHITE DWARFS IN THE GENERAL RELATIVITY THEORY. Arutyanyan, G. G.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 3, 274-280(1971).

Translated from Astrofizika; 7: No. 3, 467-479(1971).

The principal integral characteristics of rotating white dwarfs are presented which have been calculated in the Ω^2 approximation (Ω is the angular velocity) with and without allowance for the neutronization effect. (auth)

5810 FLARE STARS IN THE PLEIADES. II. Ambartsumyan, V. A.; Mirzoyan, A. V.; Parsamyan, E. S.; Chavushyan, O. S.; Erastova, L. K. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 189-196(1971).

Translated from Astrofizika; 7: No. 3, 319-331(1971).

The results are given of observations of flare stars in the Pleiades at Byurakan in the winter of 1969–1970 and partly in the second half of 1970. They are supplemented by observations at Asiago and Konkoly. Of 44 new flare stars, 14 were detected on the plates of the 40", 11 on the plates of the 21" Schmidt telescopes of the Byurakan Observatory, 15 at Asiago, 2 at the Konkoly Observatory, one independently at Byurakan and Asiago, and one simultaneously in the two Byurakan telescopes. The total number of already known flare stars in the region of the Pleiades (16 square degrees) is 208. Some of these are probably not members of the cluster. It is estimated that the lower limit to the number of flare stars in this region is 700. Evidence in favor of strong, but slow, variations in the activity of some flare stars in the Pleiades is given. In the Appendix are given data on flare stars in the Pleiades observed at Byurakan after the paper was submitted. (auth)

5811 SPECTROPHOTOMETRIC STUDY OF CERTAIN T TAURI STARS AND RAPID IRREGULAR VARIABLES. Zaitseva, G. V. Astrophysics (Engl. Transl.); 7: No. 3, 197-203(1971).

Translated from Astrofizika; 7: No. 3, 333-344(1971).

The author investigated the absolute energy distribution in the continuous spectrum of four I sa and two T Tau stars in the 4000 to 6000 Å region on the basis of slit spectrograms obtained on the 125-cm reflector of the Southern station of the Shternberg Astronomical Institute, with dispersions of 140 and 250 Å/mm. The spectrophotometric gradients and stellar temperatures corresponding to them were determined with consideration of interstellar light absorption, as were the line intensities. The majority of the investigated stars have a spectrophotometric temperature corresponding to its spectral class. UX Orion has excess reddening. (auth)

5812 SPECTROPHOTOMETRIC STUDIES OF NONSTABLE STARS. II. On the Spectrum of RW Aurigae in the Region 3080 to 6100 A. Chalonge, D.; Divan, L.; Mirzoyan, L. V. (Institut d'-Astrophysique de Paris). Astrophysics (Engl. Transl.); 7: No. 3, 204-215(1971).

Translated from Astrofizika; 7: No. 3, 345-362(1971).

The results of a spectrophotometric study of RW Aur based on five short dispersion spectra covering the region 3080 to 6100 Å are presented. The strongest absorption and emission multiplets were identified; the Balmer lines were present sometimes in emission, sometimes in absorption; Ca II (H and K in emission), Fe II (generally in emission), Ti II, Cr II (absorption); the results agreed with those recently published by Gahm, but they also covered the short wavelength region 3080 to 3250 Å. A rough determination of the continuum was made; the spectrum taken at the time of the highest luminosity presented the strongest absorption features: the Balmer lines were visible in absorption except the first ones, and a faint positive Balmer jump was present; the four other spectra corresponded nearly to the same fainter luminosity (about one magnitude lower than the preceding at 4250 Å): one of them was similar to the bright one but with less absorption, and the three others contained more intense emission lines, together with Balmer lines and Balmer continuum in emission. The lower luminosity emission spectra presented a strong ultraviolet excess compared to the higher luminosity absorption spectrum, and this excess seemed to be due, for the largest part, to the Balmer continuum. (auth)

5813 RESULTS OF SPECTRAL OBSERVATIONS OF CH CYGNI FOR 1967–1969. Dzhimsheleishvili, G. N. (Abastumani Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 216-224(1971).

Translated from Astrofizika; 7: No. 3, 363-375(1971).

The article discusses the results of spectral observations of the semiregular variable CH Cyg during 1967–1969 carried out on the meniscus prismatic camera of the Abastumani Astrophysical Observatory. The variations in the continuous spectrum were studied and then compared with the variations of the relative monochromatic brightness of the star. A relation between continuous radiation in violet light and change of emission in hydrogen lines was noted. The variations of continuous radiation in red, green and blue light are attributed partially to the spectrum of the red component of CH Cyg. (auth)

5814 MOVEMENT OF MATTER IN THE SHELL OF P CYGNI. Astaf'ev, E. R. (Rostov-on-Don State Univ., USSR). Astrophysics (Engl. Transl.); 7: No. 3, 225-230(1971).

Translated from Astrofizika; 7: No. 3, 377-387(1971).

The displacement velocity of the outer "cutoffs" of the absorption lines of P Cyg were measured on the basis of five high-dispersion spectrograms. The velocities, normalized according to line intensities, show a direct dependence on the ionization potential. Thus, stratification of matter in the shell of P Cyg is absent. Decreasing movement of matter exists in the shell of P Cyg. (auth)

5815 EVOLUTION OF A HORIZONTAL BRANCH POPULATION II STAR WITH TOTAL MASS 0.63 $M_\odot$. Laskarides, P. G. (Univ. of Athens). Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 169–177(1973).

The theoretical evolution of a horizontal branch star of Population II is followed through the helium burning in the core phase and is compared with the results given by other investigators. The influence of different physics and interpolation schemes in the opacity tables is discussed. Some thoughts are given on the explanation of the erratic period variations observed in some of the RR Lyrae variables in the globular clusters. (auth)

5816 BORN APPROXIMATION FOR PERTURBATIONS OF A SPHERICAL STAR AND THE NEWMAN–PENROSE CONSTANTS. Friedman, J. L. (Univ. of Chicago). Proc. Roy. Soc. (London), Ser. A; 335: No. 1601, 163-190(30 Oct 1973).

The field equations governing perturbations of a spherical star in general relativity are solved by means of a weak field or Born approximation. Formal expressions for the far field of a non-stationary source are obtained and used to discuss the Newman–Penrose constants. (auth)

5817 RADIATION TRANSPORT IN SPECTRAL LINES. Athay, R. G. Geophysics and Astrophysics Monographs. Volume 1. Dordrecht, Netherlands; D. Reidel Publishing Company (1972). 272p. $24.50.

This book consists of a discussion of photon transport in spectral lines, where emphasis is laid on problems related to the formation of spectral lines in stellar atmospheres, using a model solar atmosphere as reference. (WDM)

5818 COLLOQUIUM ON SUPERGIANT STARS. Proceedings of the Third Colloquium on Astrophysics Held in Trieste, Italy, September 6–8, 1971. Hack, M. (ed.). Trieste, Italy; Osservatorio Astronomico di Trieste (1971). 372p. (In English and French). (CONF-710989-).

Forty-five papers were presented on all aspects of supergiant stars. (WDM)

5819 NONEQUILIBRIUM COMPOSITION OF NEUTRON-STAR SHELLS AND NUCLEAR ENERGY SOURCES. Bisnovatyi-Kogan, G. S.; Chechetkin, V. M. (Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 437-440(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 617-618(5 Jun 1973).

The question of the chemical composition of matter at densities $\rho = 10^{10}$ to 10^{14} g/cm^3, corresponding to shells of neutron stars, was recently considered by Baum, et al. (1971) and Arponen (1972). However, it was assumed in these as well as in earlier papers that the matter of the neutron star is in a lower energy state. It is shown, on the basis of an analysis of the process of neutron-star formation, that the state of complete minimum of the energy is not reached in neutron-star shells at densities $10^{14} \lesssim \rho \lesssim 10^{11}$ g/cm^3. A large excess of nonequilibrium neutrons is produced, and their reserve of nuclear energy could ensure a neutron-star luminosity at a level $\sim 10^{36}$ erg/sec for $\sim 3 \times 10^5$ years. (WDM)

5820 ATOMS, DIATOMIC MOLECULES, AND LONG MOLECULAR CHAINS IN SUPERSTRONG MAGNETIC FIELDS. Constantinescu, D. H. (Scuola Normale Superiore, Pisa, Italy). Lett. Nuovo Cim.; 7: No. 17, 876-878(25 Aug 1973).

The formation of long molecular chains, as compared to separate atoms or diatomic molecules, is explored. The purpose is to understand how the preference for longer configurations, obvious in the asymptotic limit of an infinitely strong magnetic field, is modified, in a superstrong but finite field, by the dependence on the atomic number of the nuclei present and on the number of atoms which join together. The increase of any of these parameters increases both the attractive and repulsive parts of the forces involved, and it is this delicate balance which determines the threshold values of the magnetic field at which a certain configuration becomes favored with respect to "shorter" ones. (WDM)

5821 POSSIBLE INDIRECT METHOD FOR THE DETECTION OF γ-RAY FLASHES FROM SUPERNOVAE. Porter, N. A. (University Coll., Dublin). Nature (London); 245: No. 5425, 366-367 (19 Oct 1973).

Reference is made to the electron–photon cascade calculations of Messel and Crawford (Electron–Photon Shower Distribution Function (Pergamon Press, Oxford, 1970)) which it is stated contain a feature that has not attracted much attention. Although the secondary electrons reach maximum numbers and die away in a fashion broadly consistent with previous calculations, very low energy γ rays persist in relatively large numbers to great depths of absorber. If these findings are correct a burst of high energy γ rays striking the top of the atmosphere may be observable with a γ-ray detector of feasible size and efficiency at sea level, and because of the very slow attenuation such a system may be more effective at sea level than at mountain or balloon altitude. Estimates of the γ-ray flash from a supernova have been made and are discussed. A supernova in the Virgo cluster is estimated to produce a burst of 3×10^4 to 3×10^5 2-MeV γ rays per square meter at sea level and this would be easily detectable, although it could be confused with an extensive air shower. In another estimate, using a modified theory, however, the expected flux is reduced to about 10^{-7} erg/cm^2 in about 10 ms. Yet another estimate for ultra high-energy γ rays predicted 10^{44} ergs of $\sim 10^{12}$ eV photons from a type 1 supernova. For a distance of 10 Mpc this would produce 10^{-8} ergs/cm^2 at the top of the atmosphere, which fails in detectability by about two orders of magnitude. Energy fluxes of 10^{-5} to 4×10^{-4} ergs/cm^2 between 0.2 and 1.5 MeV have been reported in satellite observations of low energy γ-ray bursts, that may come from supernova explosions. The findings may be applicable to searches for γ rays from phenomena other than supernovae. An experimental test of the theory is desirable; this would be difficult in air, but in light solids, or Cu or Pb, where similar predictions are made, it would seem relatively easy at accelerator energies. The method may be feasible at mountain altitudes, though larger cosmic-ray backgrounds will complicate matters. The method appears suitable only for signal durations less than about 10 ms. (UK)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 5757, 5805, 5931, and 5938.

5822 THE ABSORPTION-LINE SPECTRUM OF THE BRIGHT QSO MARKARIAN 132. McKee, C.F.; Sargent, W.L.W. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. Lett. 182: No. 3, L99-L101 (15 June 1973).

Markarian 132 is a radio-quiet QSO with an emission-line redshift of $z_{em} = 1.758$. It also has a rich absorption-like spectrum: we list 24 absorption lines found in the wavelength range γγ3200–4600. Eight of these lines are identified with an absorption redshift $z_{abs} = 1.7319$. There is weaker evidence for additional redshifts $z_{abs} = 1.6834$, 1.4721, and 1.2750. Even if these are correct, many absorption lines remain unidentified. (auth)

5823 UHURU OBSERVATIONS OF THE BINARY X-RAY SOURCE 2U 0900–40. Forman, W.; Jones, C. (Harvard College Observatory, Cambridge, Massachusetts); Tananbaum, H.; Gursky, H.; Kellogg, E.; Giacconi, R. Astrophys. J. Lett. 182: No. 3, L103-L107 (15 June 1973).

Uhuru observations show that 2U 0900–40 is an eclipsing binary with a period of 8.95±0.02 days, confirming the report by Ulmer et al. The X-ray spectrum is flat and shows a large amount of low-energy absorption. The 2–6 keV intensity of the source is highly variable. The identification of 2U 0900–40 with HD 77581 is discussed. (auth)

5824 OPTICAL STUDIES OF UHURU SOURCES IV. THE LONG-TERM BEHAVIOR OF Hz Herculis=Hercules X-1. Jones, C.A.; Forman, W.; Liller, W. (Harvard College Observatory, Cambridge, Massachusetts, 02138). Astrophys. J. Lett. 182: No. 3, L109-L112 (15 June 1973).

Harvard photographs of HZ Herculis taken during the period 1890–1972 reveal the following: (1) The orbital period has remained constant at 1.70017 days to within two parts in 10^5 since 1900. (2) HZ Her does not always display the 1.7-day light variation. (3) When the 1.7-day variation is not detectable, one observes a second brightness fluctuation with an amplitude of $\Delta m_{pg} = 0.28 \pm 0.06$ and a period half that of the orbital motion. (auth)

5825 ABSENCE OF H_2CO 6-CENTIMETER HYPERFINE ANOMALIES IN A DUST CLOUD. Heiles, C. (Astronomy Department, University of California, Berkeley); Turner, B.E. Astrophys. J. Lett. 182: No. 3, L121-L124 (15 June 1973).

Apparent hyperfine anomalies inferred earlier by Dieter for a dust cloud are shown to result instead from the presence of a second velocity component. (auth)

5826 THE H II REGION G333.6–0.2, A VERY POWERFUL 1–20 MICRON SOURCE. Becklin, E.E. (California Institute of Technology); Frogel, J.A.; Neugebauer, G.; Persson, S.E.; Wynn-Williams, G.C. Astrophys. J. Lett. 182: No. 3, L125-L129 (15 June 1973).

G336.6–0.2 has been found to be one of the brightest 20-micron sources in the sky, and the most luminous H ii region known in the wavelength range 1–25 μ. Despite its high luminosity it consists of only a single component with a diameter of 11" (0.2 pc). The source appears to be a dust-filled compact H ii region. (auth)

5827 PRELIMINARY RESULTS OF OBSERVATIONS OF DISCRETE SOURCES AND OF JUPITER WITH 2-cm WAVELENGTH AT PULKOVO. Bogod, V.M.; Golubchina, O.A.; Mirovskii, V.G.; Pyatunina, T.B.; Soboleva, N.S.; Strukov, I.A.; Fridman, P.A. (Main Astronomical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 1, 47-53 (July 1973).

The article reports preliminary results of the investigation of a number of discrete sources and of Jupiter at the 2-cm wavelength, using the large radio telescope at Pulkovo (directional diagram in the horizontal direction, from 38 to 47 arc sec) and a receiver having a

sensitivity of 0.03°K with a time constant of 1 sec and a bandwidth of ≈1000 MHz. For the observations (excluding those of Jupiter), a radio-astronomical method was used for adjusting the surface of the main mirror with the help of the sun. The effective area of the radio telescope at this wavelength was ≈50 m². The article demonstrates the absence of point details in the Orion Nebula with a flux density over three units. Evidently, the compact sources are nonuniformities of density in equilibrium with the surrounding medium. An additional source has been discovered in the Omega Nebula close to the position of an optical object (the frequency of the inflection in the spectrum is possibly greater than 15 GHz). An estimate is made of the electron density inside the region of strong polarization in the Crab Nebula, and it is shown that it is less than that of the interstellar medium. It is noted that there is no point source in Tau-A with a flux density over 1.7 units. The horizontal width of the radio galaxy Virgo-A in the 2-cm wavelength is $(29\pm2)'$. The emission maximum is displaced eastward from the optical nucleus by $(17\pm10)''$, that is, toward the new jet. Radio-emission brightness distribution over Jupiter's disk, at the 2-cm wavelength, shows limb darkening. Therefore the temperature of Jupiter's atmosphere increases with depth. (auth)

5828 SUPERNOVA OUTBURSTS AND THE FORMATION OF RELATIVISTIC OBJECTS. I. Guseinov, O.K.; Kasumov, F.K.; Lazarev, V.I.; Osipchuk, A.V. (Shemakha Astronomical Observatory). Sov. Astron.-AJ 17: No. 1, 24-29 (July 1973).

A genetic relationship between a pulsar and a supernova remnant may be considered persuasive only if they are <30 pc apart. Just two pairs satisfy this criterion: P0531—Crab and P0833—Vela; in these cases the components also agree in age. The scarcity of pairs suggests that supernova remnants disperse quite rapidly (in $\simeq 4.10^4$ yr); thus the pulsars quickly become isolated, achieving a space density one to two orders of magnitude greater than that of supernova remnants. (auth)

5829 RADIO HALOS AROUND DOUBLE RADIO SOURCES. Kuril'chik, V.N. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 1, 42-46 (July 1973).

The excess long-wave radio emission observed in many double radio sources is definitely associated with extended halos around these objects. The radio spectra of the halos and the double structures themselves are closely related, suggesting that these components all originated in some common event. Cluster and field radio galaxies tend to have different spectral types (L and M, respectively). An estimate of the physical parameters of the radio halos indicates a predominance of the inverse Compton effect for relativistic electrons on the 3°K background radiation field. Radio halos can be powerful sources of hard x rays: Their typical spectral behavior agrees with the observed x-ray background. (auth)

5830 NATURE OF THE LUMINOUS CENTRAL OBJECTS IN NGC 3603 AND 30 DORADUS. Walborn, N. R. (Univ. of Toronto). Astrophys. J.; 182: No. 1, L21-L23(15 May 1973).

Classification spectrograms and short-exposure photographs of the central objects in the giant H II regions NGC 3603 and 30 Doradus are illustrated and discussed. The NGC 3603 object is shown to be a very luminous Trapezium-like system including a Wolf-Rayet component. Because of the spectroscopic similarities, it is suggested that the 30 Dor object may also be such a system. (auth)

5831 CONSTRAINTS ON COSMIC MASER INTENSITY, AND THE POSSIBILITY OF DETECTING NEW OH AND H_2O RADIO SOURCES BY A RAPID SKY SURVEY. Rudnitskii, G.M.; Strel'nitskii, V. A. (State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 1049-1050(1973).

Translated from Astron. Zh.; 49: No. 6, 1323-1325(1972).

Certain constraints on the intensity of cosmic maser sources in the OH and H_2O lines are discussed. Even if the radiation is only weakly directional, with the maser having a solid angle of ≈1 sr, masers with a brightness temperature as high as 10^{17} °K could exist. Maser sources whose flux density is comparable to the brightness values now observed ought to be detectable in a rapid sky survey with relatively simple equipment. (auth)

5832 INFRARED AND RADIO TRANSITION PROBABILITIES OF OH AND CH. Burdyuzha, V. V.; Varshalovich, D. A. (State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 980-982(1973).

Translated from Astron. Zh.; 49: No. 6, 1211-1215(1972).

All radiative transition probabilities from the lowest rotational levels to the Λ-doublet levels are calculated for the OH and CH molecules. (auth)

5833 INTERFEROMETRY OF THE MEDUSA NEBULA A21 (YM 29). Lozinskaya, T. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 945-948 (1973).

Translated from Astron. Zh.; 49: No. 6, 1158-1163(1972).

The nebula A21 was observed with a high-contrast Fabry-Perot etalon and a contact electronic image converter in the 6584- and 6563-Å lines. The model best satisfying the observations is a thin prolate-ellipsoidal shell inclined $50 \pm 15°$ to the plane of the sky; its axial ratio is 0.4 ± 0.2, and its thickness is no more than 0.3 of its mean radius. The mean radial velocity of the nebula as a whole is $+24 \pm 5$ km/sec relative to the local standard of rest. The shell is found to be expanding at a velocity of 53 ± 10 km/sec. With this expansion velocity the nebula cannot be a supernova remnant, a result consistent with the radio observations. (auth)

5834 B2 CATALOGUE OF RADIO SOURCES. III. Colla, G.; Fanti, C.; Fanti, R.; Ficarra, A.; Formiggini, L.; Gandolfi, E.; Gioia, I.; Lari, C.; Marano, B.; Padrielli, L.; Tomasi, P. (Univ., Bologna). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 291-325 (Sep 1973).

The catalog lists 3227 radio sources observed at 408 MHz with the Bologna Northern Cross Telescope. It covers an area of 0.55 ster. between 34°02′ and 40° 18′ down to 0.25 f.u. Results are given on the differential log S-log N relationship and on extended radio sources. (auth)

5835 RADIO SPECTRUM OF IC 443. Hill, I. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 39P-41P (1973).

The distribution of the radio spectral index over the supernova remnant IC 443, derived from maps at 1.4 and 10.7 GHz, confirms the relative steepening at high frequencies of the spectrum near the brightest optical features (or an equivalent flattening elsewhere). The series of lunar occultations during 1974 will provide an opportunity for investigation of the detailed brightness distribution at lower frequencies, which may throw light on the reason for the spectral variation. (auth)

5836 MULTIPLE EXPLOSIONS AND THE EVOLUTION OF RADIO GALAXIES. Christiansen, W. A. (Univ. of North Carolina, Chapel Hill). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 211-221 (1973).

The possibility of sequential explosions in radio galaxies is discussed and it is shown that if multiple explosions do occur, most radiosources will be ejected into a medium which has not recovered from the effects of previous explosions. The most important dynamical effect of previous explosions is the formation of a low density cavity along the axis of the old radio source. This cavity allows ejecta from subsequent explosions to achieve high translational velocities down the channel without suffering significant expansion or radiation losses. The dynamics of secondary sources travelling down such a channel is discussed, and it is shown that such secondary sources achieve their maximum surface brightness and luminosity at the end of the channel when they overtake the primary cloud. (auth)

5837 CONCERNING ANOMALOUS FORMALDEHYDE HYPERFINE LINES IN THE DUST CLOUD L1436. Crutcher, R. M. (California Inst. of Tech., Pasadena). Astrophys. J.; 182: No. 2, L71-L72(1 Jun 1973).

It is shown that there is no evidence for nonequilibrium hyperfine component intensities of formaldehyde in the dust cloud L1436. (auth)

5838 AMMONIA IN DR 21(OH) AND NGC 2264. Mayer, C. H. (Naval Research Lab., Washington, DC); Waak, J. A.; Cheung, A. C.; Chui, M. F. Astrophys. J.; 182: No. 2, L65-L69 (1 Jun 1973).

NH_3 (1,1) and (2,2) line emission spectra were measured in the DR 21(OH) region and in a new NH_3 region in NGC 2264. Hyperfine structure of the (1,1) transition was resolved, providing data on optical depth and excitation temperature for calculation of column densities and kinetic temperatures. (auth)

5839 EXTRAGALACTIC RADIO SOURCES. Kellerman, K. I. (National Radio Astronomy Observatory, Green Bank, WV). Phys. Today; 26: No. 10, 38-41(Oct 1973).

Topics reviewed in some detail include energy of radio sources, classification of radio sources, extended sources, compact sources, intensity variations, variations in structure, and the current situation. (WDM)

5840 HCN RADIO EMISSION FROM THE HOURGLASS REGION OF M8. Giguere, P. T. (Univ. of Virginia, Charlottesville); Snyder, L. E.; Buhl, D. Astrophys. J.; 182: No. 1, L11-L12(15 May 1973).

Radio emission from the J = 1-0 line of $^{12}H^{14}CN$ was detected from the Hourglass region of M8, which includes Herschel 36, an O7 star of known optical properties embedded in dust. The HCN cloud is extended from Herschel 36 throughout the Hourglass region. Implications of this detection are discussed. (auth)

5841 INFRARED PHOTOMETRY OF THE X-RAY SOURCES 2U 0900-40 AND 2U 1700-37. Frogel, J. A.; Persson, S. E.

(Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 85: No. 507, 641-642(Oct 1973).

Infrared observations from 1.25μ to 3.5μ of the candidate stars show that the infrared color indices are normal for stars of the observed spectral type. The variability at 2.2μ is less than ±0.1m in each case. (auth)

5842 DISTANCE TO THE CRAB NEBULA AND NP 0532. Trimble, V. (Univ. of California, Irvine). Publ. Astron. Soc. Pac.; 85: No. 507, 579-585(Oct 1973).

Twelve lines of evidence bearing on the determination of the distance to the Crab Nebula and NP 0532 are discussed. Some of these depend on the dynamics of the nebular expansion, some on physical processes in the supernova or its remnant, and some on the nature of the intervening interstellar medium. An unweighted average of the various methods yields a distance of about 1930 pc. (auth)

5843 NONLINEAR ABSORPTION COEFFICIENT OF ELECTROMAGNETIC RADIATION UNDER ASTROPHYSICAL CONDITIONS. Kaplan, S. A.; Khaplanov, G. M.; Khronopulo, Yu. G. (Scientific Research Radiophysics Inst., Gorky, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 294-296(1971).

Translated from Astrofizika; 7: No. 3, 501-505(1971).

The influence of powerful high-frequency electromagnetic radiation on the absorption coefficient in the low-frequency line in a three-level atom is considered (it is assumed that the second level is close to the first, ground, level; i.e., $\omega_{12} \ll \omega_{13} \approx \omega_{23}$). The nonlinear portion of the absorption coefficient at the frequency ω_{12} is proportional both to the radiation density at the frequencies ω_{13}, ω_{23} and to the difference $A_{32}-A_{31}$ of the Einstein coefficients of the spontaneous transition. In particular, buildup of electromagnetic radiation is possible at low frequencies and for direct (not inverse) population of the levels, provided that $A_{32} < A_{31}$. (auth)

5844 QUASISTELLAR RADIO SOURCES AND OPTICAL QUASISTELLAR OBJECTS. Arakelyan, M. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 269-273(1971).

Translated from Astrofizika; 7: No. 3, 457-465(1971).

The distributions of the redshifts and luminosities of quasistellar radio sources and optical quasistellar objects are compared. The differences between the distributions of these two types of objects allow the conclusion to be drawn that their luminosity functions are not identical. The relative number of quasistellar radio sources and optical quasistellar objects increases with luminosity. The average luminosity of quasistellar radio sources is at least 1.5 times in excess of the average luminosity of optical quasistellar objects. (auth)

5845 MODELS OF EXTENDED RADIO SOURCES. Longair, M. S.; Ryle, M.; Scheuer, P. A. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 243-270(1973).

Some of the basic requirements of viable models of double radio sources are examined. Some models require large mass densities in the most intense radio components and can now be excluded because they predict observable optical emission from the radio components which is not observed. The process of transporting energy from the central object to the radio components is studied, with a view to defining the conditions in which energy can be conveyed without prohibitive losses by adiabatic expansion. It appears likely that energy, and also mass, is brought into the radio components over a time scale comparable with the age of the source. A basic difficulty in accumulating mass in a radio component is outlined. (auth)

5846 NEW OBSERVATIONS OF 3C382, 3C452, AND 3C465 AT 2.7 AND 5 GHz. Riley, J.M.; Branson, N. J. B. A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 271-287(1973).

The radio sources 3C 382, 3C 452, and 3C 465 have been mapped with the Cambridge One-Mile telescope at 2.7 and 5 GHz and with the Five-Kilometre telescope at 5 GHz. Each source has a central component less than 2" arc in diameter which is coincident with the nucleus of a galaxy, and outer components of considerable complexity. The extended components of 3C 452 and 3C 465 are significantly polarized. The observations are discussed in terms of different models for extended radio sources. None of the simple models can adequately account for all the observed features, but modifications of these models are proposed to obtain qualitative agreement with the observations. Several correlations between the physical properties of different extended sources are proposed. (auth)

5847 INFRARED AND X-RAY VARIABILITY OF CYG X-3. Becklin, E. E. (Hale Observatories, Pasadena, CA); Neugebauer, G.; Hawkins, F. J.; Mason, K. O.; Sanford, P. W.; Matthews, K.; Wynn-Williams, C. G. Nature (London); 245: No. 5424, 302-304 (12 Oct 1973).

It is stated that Cygnus X-3 is a candidate for the radio source that in September 1972 experienced a series of exceptional radio outbursts. The x-ray emission is chiefly distinguishable in showing periodic intensity variations with a period of 4.8 hr., and if these variations are caused by an eclipse the orbital period is the shortest observed so far for an x-ray source. Definite identification of the radio source with the x-ray source has remained unconfirmed because of the poor positional accuracy of the x-ray source. A description is given of the coordinated x-ray and infrared observations at Cyg X-3, leading to the discovery of a synchronous 4.8 hr. periodicity in the flux density of the infrared source. This uniquely associates the x-ray with the infrared source and hence, through the positional coincidence, with the radio object. In addition short term variability in the infrared flux of Cyg X-3 was observed, that may be related to the flares seen at radio wavelengths. An infrared estimate of the x-ray position was also obtained. The main infrared observations were made at the Cassegrain focus of the Hale 200 inch telescope in July 1973, and the x-ray data were obtained using a collimated proportional counter, sensitive in the 1 to 3 A wavelength range, on board the Copernicus spacecraft. Following the discovery of the infrared object refined measurements were obtained on the position and size of the infrared source, as well as other infrared sources in the field. The source diameter was found to be<3 arc s. Periodicity of the x-ray data was duplicated by the infrared data. Measurements of the colour of Cyg X-3 were also made. It was concluded that the x-ray, infrared, and radio emission all originate from the same system, and it is strongly suggested that Cyg X-3 is an eclipsing binary system, additional evidence for this is also presented; comparisons are made with Sco X-1, and models are discussed. (UK)

5848 UPPER LIMITS TO THE PULSED X-RAY FLUX FROM PSR0833-45, MP0835-40, AND MP0736-40. Cruise, A. M.; Newton, A. C. (University Coll., London). Nature (London) Phys. Sci.; 244: No. 138, 121-122(20 Aug 1973).

Some observations are described that were obtained with a collimated proportional counter, sensitive to x rays in the energy range 2.8 to 9.9 keV, flown on a Sun-stabilized Skylark sounding rocket launched from Woomera, S. Australia in November 1970. During part of the flight the detector field of view was scanned across Vela, including the position of the three radio pulsars PSR 0833-45, MP 0835-40, and MP 0736-40. Tables are given showing upper limits to the time averaged pulsed flux from the three radio pulsars, together with upper limits to their steady flux. The strong dependence of luminosity on period makes it very unlikely that MP 0833-40 and MP 0736-40 would be detectable at x-ray wavelengths, although it is emphasized that failure to detect pulsed emission is not proof that such emission does not occur since the photon beam may not intersect the Earth. The Vela pulsar MP 0835-40, however, might be expected to be detectable at x-ray energies, in view of its short period. (UK)

5849 OBSERVATION OF AN OFF STATE IN CIRCINUS X-1. Tuohy, I. R.; Davison, P. J. N. (University Coll., London). Nature (London) Phys. Sci.; 244: No. 138, 121(20 Aug 1973).

Circinus X-1 is stated to be a highly variable x-ray source but its pulsations do not appear to show a stable period; it is therefore similar to Cygnus X-1, which exhibits pulse trains with periods between 0.3 and 10 s. Observations are reported, made in June 1973 by the Copernicus satellite, showing that Circinus X-1 has an "off state" exceeding 13 h, suggesting an eclipsing phenomenon. Such behavior is well established in several other x-ray sources. (UK)

5850 CARINA NEBULA AT 30 MHz. Jones, B. B. (Univ. of Sydney). Aust. J. Phys.; 26: No. 4, 545-550(Aug 1973).

A map of the Carina nebula, with 50' arc resolution, was made using the 30 MHz aperture synthesis telescope at Fleurs. At this frequency the nebula appears in absorption. A strong nonthermal source, presumably a supernova remnant, was found in front of the nebula. Estimates of the emissivity in this region from brightness temperatures were found to vary markedly over the extent of the nebula. The average measured emissivity was lower than that in the local arm, suggesting the presence of an interarm gap between the Sun and the nebula. (auth)

5851 POLARIMETRIC INVESTIGATION OF COMPACT EXTRAGALACTIC OBJECTS. Dombrovskii, V. A.; Babadzhanyants, M. K.; Gagen-Torn, V. A.; Gutkevich, S. M. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 7: No. 3, 246-256(1971).

Translated from Astrofizika; 7: No. 3, 417-434(1971).

The results of polarimetric and, in some cases, photometric observations of compact extragalactic objects — quasars and

nuclei of various galaxies are presented. The observations were made at the Byurakan astrophysical station of Leningrad University by means of an electropolarimeter installed on a 20-inch reflector, mainly in 1968–1970. The results of the observations are presented in five tables, a part of which should be considered a continuation of corresponding tables from a previous article (1968). The data of the tables show that polarization is characteristic of the radiation of many compact extragalactic objects. A variation of polarization parameters with time was reliably established for a number of objects. A graphic comparison of the polarization and photometric data is made for four objects. (auth)

Solar Phenomena

Refer also to abstracts 5738 and 5740.

5852 (LA-UR-73-1304) TEMPORAL OBSERVATIONS OF THE λ5303 EMISSION LINE PROFILE DURING THE 74 MINUTE TOTALITY FROM THE CONCORDE SST AT THE 30 JUNE 1973 TOTAL SOLAR ECLIPSE: PRELIMINARY INTENSITY VARIATIONS ABOVE AN ACTIVE REGION. Liebenberg, D. H.; Hoffman, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 28 Aug 1973. 9p. (CONF-730953-1). Dep. NTIS $3.00.

From international astronomical union symposium on coronal disturbances; Surfers Paradise, Australia (3 Sep 1973).

Apparatus was designed for installation on the Concorde SST to provide high resolution emission line profiles at the June 30, 1973 total solar eclipse. A prime objective was to obtain profiles that could be used to detect the coronal response to the 5 min periodicities observed in the solar photosphere. Stability of the sky scattered light, drastic reduction of seeing effects enhanced the value of the exceptional opportunity. Preliminary results are discussed for a single region on the limb, above an active sunspot group. (auth)

5853 VALIDITY OF CGL EQUATIONS IN SOLAR WIND PROBLEMS. Schulz, M. (Space Physics Laboratory, The Aerospace Corporation, El Segundo, California, 90245); Eviatar, A. J. Geophys. Res. 78: No. 19, 3948-3951 (1 July 1973).

The double adiabatic equations of state are derived algebraically from Liouville's theorem for an azimuthally symmetric proton exosphere throughout which the bulk velocity greatly exceeds the proton thermal velocities. The calculated skewing of the distribution function f(v) in the solar exosphere is found to agree qualitatively with observation and with the direction of heat flow inferred from $-\nabla T_{\parallel}$. (auth)

5854 CORONAL PROPAGATION OF LOW-ENERGY SOLAR PROTONS. Lanzerotti, L.J. (Bell Laboratories, Murray Hill, New Jersey ,07974). J. Geophys. Res. 78: No. 19, 3942-3947 (1 July 1973).

The onset times at 1 AU of solar protons produced by discrete flare events are investigated as a function of solar flare longitude and particle energy for protons of energy 0.6–25 Mev. The results are interpreted in terms of particle transport in the solar corona; a coronal diffusion coefficient $\kappa_c \simeq 3\times10^{18}$ cm^2/sec at an altitude of ≈5Rs above the photosphere would explain the observations quite well. This value of κ_c is consistent with the coronal diffusion coefficent determined by Fisk and Schatten (1972) from considerations of the azimuthal spread of solar particles during the decay phase of several solar particle events. (auth)

5855 ABUNDANCE OF SOLAR COSMIC RAY ALPHA PARTICLES. Lanzerotti, L.J.; Maclennan, C.G. (Bell Laboratories, Murray Hill, New Jersey, 07974). J. Geophys. Res. 78: No. 19, 3935-3941 (1 July 1973).

The abundance ratio of the fluxes of low-energy (1–10 Mev/nucleon) solar alpha particles to solar protons varies from flare to flare and with time within a single flare event. The fluxes of solar protons and alphas from seven of the large-flare events during the maximum of solar cycle 20 have been integrated over the duration of the events. The event-averaged $^4He/^1H$ ratio is found to vary as 0.026 (Mev/nucleon)$^{-0.2}$ in the range 1–10 Mev/nucleon. For particles compared as to equal energy per charge (a representation that may have less distortion from propagation effects) the ratio $^4He/^1H \approx 0.05$ (Mev/Z)$^{-0.2}$. In this representation, for 1 Mev/Z particles, the solar cosmic ray $^4He/^1H$ ratio is compatible with (1) the average solar wind helium abundance and (2) a solar helium abundance determined from spectroscopic studies of prominences and the chromosphere but is less than (3) helium abundances predicted from some current models of the solar interior. (auth)

5856 REPLY. Holzer, T.E. (Aeronomy Laboratory, NOAA Environmental Research Laboratories, Boulder, Colorado, 80302); Leer, E. J. Geophys. Res. 78: No. 16, 3199-3201 (1 June 1973).

Certain difficulties involved in the formulation of the hydrodynamic model of Wolff et al. are pointed out. Two separate arguments are presented, which support the conclusion that viscous effects on the solar-wind proton gas are not important beyond 0.1 AU. (WDM)

5857 COMMENTS ON A PAPER BY R. B. McKIBBEN, 'THE AZIMUTHAL PROPAGATION OF LOW-ENERGY SOLAR-FLARE PROTONS'. Simnett, G.M. (Physics Department and Institute of Geophysics and Planetary Physics, University of California, Riverside, California, 92502). J. Geophys. Res. 78: No. 7, 1235-1238 (1 Mar 1973).

McKibben (1972) proposed that the solar particle event that was observed to start at the Earth around 1430 UT, July 12, 1968, most likely originated in a flare on the invisible side of the Sun at around 190° west of the Earth–Sun line. It is suggested that this observation is in direct contradiction to the explanation for this event proposed by Simnett and Holt (1971), and it is pointed out that the available experimental evidence, including the most recent data, is weighted against McKiffen's suggestion. (WDM)

5858 REPLY. McKibben, R.B. (Laboratory for Astrophysics and Space Research, Enrico Fermi Institute, University of Chicago, Chicago, Illinois, 60637). J. Geophys. Res. 78: No. 7, 1239-1242 (1 Mar 1973).

Three points of disagreement between Simnett and the author are discussed in detail. (WDM)

5859 ON THE MARCH 7–8, 1970, EVENT. Formisano, V. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Ricerche, Istituto di Fisica Guglielmo Marconi, Rome, Italy). J. Geophys. Res. 78: No. 7, 1198-1202 (1 Mar 1973).

The interplanetary shock of March 8, 1970, was studied by using Heos 1 plasma data. Plasma density and velocity jumped from 4 to 13 particles/cc and from 430 to 790 km/sec. The piston of the shock was observed 5–6 hours later and compressed the magnetosphere so much that it made the solar wind detectable at geosynchronous orbit. Maximum solar wind speed observed in this period was 880 km/sec. (auth)

5860 COMMENTS ON PAPER BY E. LEER AND T. E. HOLZER, 'Collisionless SOLAR WIND PROTONS: A COMPARISON OF KINETIC AND HYDRODYNAMIC DESCRIPTIONS'. Brandt, J.C.; Wolff, C.L. (Laboratory for Solar Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 16, 3197-3198 (1 June 1973).

Recently, Leer and Holzer (1972) presented a comparison of kinetic and hydrodynamic solar-wind models. Since both their models produced the same solar-wind properties at Earth, and since the hydrodynamic description did not include viscosity, they concluded that viscosity is not important in the solar wind. The present authors disagree that this conclusion applies to the real solar wind. Also it is felt that they did not demonstrate any general applicability for their conclusion that the kinetic and hydrodynamic approaches are equivalent in the solar wind. (WDM)

5861 SINGLE-FLUID MODEL OF THE DISTANT SOLAR WIND. Wallis, M.K. (Mathematical Institute, Oxford, England). J. Geophys. Res. 78: No. 16, 3155-3158 (1 June 1973).

Termination of the solar wind by ionizing interaction with neutral hydrogen gas has recently been described by Holzer (1972) with a magnetized single-fluid model under spherical symmetry and in a steady state. An exactly radial flow with an exactly transverse magnetic field was treated. This model is discussed in some detail and some of its shortcomings are pointed out. (WDM)

5862 TRAVELING REGIONS OF HIGH SOLAR WIND DENSITY OBSERVED IN EARLY AUGUST 1972. Croft, T.A. (Center for Radar Astronomy, Stanford University, Stanford, California, 94305). J. Geophys. Res. 78: No. 16, 3159-3166 (1 June 1973).

On Aug. 3 and 9, 1972 the spatial average of solar-wind electron density along the path from Earth to Pioneer 9 was observed by the dual-frequency radio technique to vary in an unusual manner. These data are discussed in some detail. (WDM)

5863 ON THE ROLE OF FLUCTUATIONS IN THE INTERPLANETARY MAGNETIC FIELD ON HEAT CONDUCTION IN THE SOLAR WIND. Cuperman, S. (CIRES, University of Colorado and Space Environment Laboratory, NOAA–ERL, Boulder, Colorado, 80302); Metzler, N. J. Geophys. Res. 78: No. 16, 3167-3168 (1 June 1973).

Recently, Hollweg and Jokipii (1972) considered the effect of random long-wavelength fluctuations in a turbulent magnetic field and showed that they can appreciably decrease the heat conductivity of a plasma along the magnetic field. Their result is applied to the solar wind and it is concluded that the main reduction of the thermal conductivity should occur at low heliocentric distances (below 30 to 40 $R_\odot$). (WDM)

5864 SOLAR FLARE COSMIC RAYS AT AND BEYOND THE MODULATION BOUNDARY. Jokipii, J.R.; Stone, E.C. (Downs

Laboratory, California Institute of Technology, Pasadena, California, 91109). J. Geophys. Res. 78: No. 16, 3150-3154 (1 June 1973).

The characteristics of solar-flare cosmic-ray events observed beyond the postulated modulation boundary, should such a boundary exist, are considered. It is pointed out that observations of solar-flare particles at large distances from the Sun provide a sensitive and precise diagnostic of any such boundary. (WDM)

5865 SOLAR FLARE PARTICLE PROPAGATION: COMPARISON OF A NEW ANALYTIC SOLUTION WITH SPACECRAFT MEASUREMENTS. Lupton, J.E.; Stone, E.C. (California Institute of Technology, Pasadena, California, 91109). J. Geophys. Res. 78: No. 7, 1007-1018 (1 Mar 1973).

A new radial solution has been obtained to the Fokker-Planck equation for solar flare particle propagation that includes the effects of convection, energy change, and anisotropic diffusion with κ_r = constant. It is assumed that the particles are injected impulsively at a single point and that there is a free escape boundary. In addition, the azimuthal solution derived by Burlaga, which was based on $\kappa_\phi \propto r^2$, has been modified to include some of the effects of solar rotation. With an outer boundary at ≈2.7 AU, a solar wind velocity of ≈400 km/sec, and $\kappa_r \simeq 2$ to $8 \cdot 10^{20}$ cm²/sec, the complete solution gives reasonable fits to the time profiles of 1- to 10-Mev protons from 'classical' flare-associated events observed with the Caltech solar and galactic cosmic ray experiment aboard Ogo 6. It is not necessary to invoke a scatter free region near the sun in order to reproduce the fast rise times observed for west limb events, indicating that κ_r = constant is a better description of conditions inside 1 AU than is $\kappa \propto r$. The radial solution also provides insight into the possible dependence of the observed decay times on various parameters and can be used as the basis for an illustrative calculation of the evolution of the vector anisotropy. (auth)

5866 ANISOTROPIES IN THE INTERPLANETARY INTENSITY OF SOLAR PROTONS $E_p > 0.3$ Mev. Innanen, W.G.; Van Allen, J.A. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa, 52240). J. Geophys. Res. 78: No. 7, 1019-1035 (1 Mar 1973).

By using Explorer 35 interplanetary observations of solar protons of $E_p > 0.3$ Mev during ten selected solar events (1967–1970) the time dependence of intensity and of the angular distribution of intensity has been studied for the first time in the sub-Mev range of energy. The respective contributions of diffusive and convective transport are resolved. Results are qualitatively similar to those of McCracken et al. (1968, 1971) in the energy range $7.5 < E_p < 45$ Mev; but, as was expected, convective transport is found to be relatively more important at the lower energies. The convective component of the anisotropy vector yields values of the solar wind velocity in good agreement with directly measured values. (auth)

5867 ACCESS OF SOLAR PROTONS TO THE EARTH'S POLAR CAPS. Fennell, J.F. (Space Physics Laboratory, Aerospace Corporation, El Segundo, California, 90245). J. Geophys. Res. 78: No. 7, 1036-1046 (1 Mar 1973).

Energetic solar proton observations ($E_p \gtrsim 300$ kev) in the interplanetary medium by Explorer 33 and Explorer 35 and over the polar caps by Injun 5 during the period September 1968 through March 1970 have been examined in detail. The solar proton intensities observed over the polar regions were compared with the interplanetary intensities on an absolute basis. The high polar latitude (HPL) proton intensities tracked the magnetic field aligned interplanetary intensities well (solar-antisolar intensities as determined from the sectored Explorer data). The tracking was in agreement with the open magnetosphere model about 90% of the time. That is, the intensities observed on the HPL magnetic lines of force, which would be connected to magnetic lines of force from the sun in an interconnected geomagnetic and interplanetary magnetic field, were in agreement with the maximum intensity of the interplanetary proton pitch angle distribution. The intensities observed at the HPL region of the opposite polar cap were in agreement with the minimum intensity of the interplanetary pitch angle distribution. The low polar latitude (LPL) intensities generally tracked the maximum interplanetary intensity very well. The solar protons appear to have access to the LPL regions via the neutral sheet region of the magnetotail. Interplanetary proton intensity structures were used to estimate the delay in access to the polar caps. Based on the assumption that the interplanetary intensity structures are convected past the earth at solar wind speeds, the estimated delay times correspond to access regions with distances from the earth of about 100 R_e for the north LPL region and 260 R_e for the north HPL region. No evidence was found to indicate that the delays in access depend on the direction of the interplanetary magnetic field. (auth)

5868 CONFIGURATION OF INTERPLANETARY SHOCK WAVES FROM POWERFUL CHROMOSPHERIC FLARES (FROM SPACE PROBE MEASUREMENTS). Ivanov, K.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Propagation of Radio Waves, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 1, 94-96 (July 1973).

The average configuration of the leading component of shock waves from strong chromospheric flares is studied using magnetic and plasma measurements on space probes in the solar wind and terrestrial optical observations of the sun. It was noted that: 1) there is a systematic difference between latitudinal and longitudinal profiles of the wave; 2) in the range of ≈0.75–1.25 AU the leading component of the wave can be approximated by a semiellipsoid having a ratio of the characteristic latitudinal and longitudinal dimensions equal to ≈2. (auth)

5869 RECONNECTION OF MAGNETIC FIELD LINES IN COMPRESSIBLE CONDUCTING FLUIDS. Yeh, T. (Southern Illinois Univ., Carbondale); Dryer, M. Astrophys. J.; 182: No. 1, 301-315(15 May 1973).

A previous study by Yeh and Axford of the reconnection of magnetic field lines in an incompressible fluid is extended to a compressible fluid. From hydromagnetic flows in similarity form, it is found that expansion takes place before the reconnection and compression after the reconnection. The pressure gradient in the radial direction causes the field lines to bend into separatrices in the incoming flows. The kinks on the reconnected field lines propagate out as slow-mode hydromagnetic shocks in the outgoing flows. In the expansion phase of the merging the magnetic energy is piled up around the separatrices, and then in the compression phase the energy is converted from magnetic into kinetic and thermal. (auth)

5870 RELATION BETWEEN THE PATTERN AND WIND VELOCITIES IN INTERPLANETARY SCINTILLATIONS. Jokipii, J. R.; Lee, L. C. (California Inst. of Tech., Pasadena). Astrophys. J.; 182: No. 1, 317-319(15 May 1973).

The relation between the pattern and wind velocities in interplanetary scintillations is reexamined, and some previous results are corrected. It is demonstrated that there is not a unique, rigid motion of the pattern and that care must be used in defining the velocity. (auth)

5871 OBSERVATIONS OF THE F CORONA AND INNER ZODIACAL LIGHT DURING THE 1972 JULY 10 TOTAL SOLAR ECLIPSE. Sandford, M. T. II; Theobald, J. K.; Horak, H. G. (Los Alamos Scientific Lab., NM). Astrophys. J.; 181: No. 1, L15-L17(1 Apr 1973).

A rocket-borne, four-color, six-channel polarimeter launched from Poker Flat, Alaska, traversed the Moon's umbra during the July 10, 1972 solar eclipse. The brightness and linear polarization of the F corona and inner zodiacal light were measured from altitudes ranging between 310 and 330 km at solar elongations to 30° east and west of the Sun. Instrumentally scattered light and a serious trajectory error degraded the data, but intensity observations made west of the Sun are less severely affected and are presented. These data overlap and extend the measures planned for the Skylab zodiacal-light experiment. Further observations are required in the 0° to 30° elongation range. (auth)

5872 POLARIZATION MEASUREMENTS IN THE GREEN CORONAL LINE. Mickey, D. L. (Univ. of Hawaii, Honolulu). Astrophys. J.; 181: No. 1, L19-L21(1 Apr 1973).

Linear polarization up to 15 percent in the Fe XIV λ5303 line was measured photoelectrically in the solar corona. The polarization deviated only slightly from the radial direction and increased with increasing height. (auth)

5873 DETERMINATION OF ATOMIC LIFETIMES AND ABSOLUTE OSCILLATOR STRENGTHS FOR NEUTRAL AND IONIZED TITANIUM. Roberts, J. R. (Univ. of Aarhus, Denmark); Andersen, T.; Sorensen, G. Astrophys. J.; 181: No. 2, 567-586(15 Apr 1973).

Measurements of atomic lifetimes by the beam-foil technique and branching ratios by use of a gas-flow stabilized arc have led to an experimental determination of absolute oscillator strengths of Ti II. Some lifetimes of Ti I, Ti III, and Ti IV are also presented. (auth)

5874 DETERMINATION OF ATOMIC LIFETIMES AND ABSOLUTE OSCILLATOR STRENGTHS FOR NEUTRAL AND IONIZED VANADIUM. Roberts, J. R. (Univ. of Aarhus, Denmark); Andersen, T.; Sorensen, G. Astrophys. J.; 181: No. 2, 587-604(15 Apr 1973).

Measurements of atomic lifetimes by the beam-foil technique and branching ratios by use of a gas-flow stabilized arc have led to an experimental determination of absolute and relative oscillator strengths of V I and V II. Some lifetimes of V III are also presented. (auth)

5875 EVOLUTION OF DUST PARTICLES IN THE SUN'S ENVIRONS. Dobrovol'skii, O. V.; Egibekov, P. (Inst. of Astrophysics, Dushanbe, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 1028-1030(1973).

Translated from Astron. Zh.; 49: No. 6, 1287-1290(1972).

The article discusses the effect of particle size variability due to evaporation and sputtering on the evolution of the particle orbit, in response to the Poynting–Robertson effect and its corpuscular analog. It was found that metallic particles with heats of evaporation of 30, 50, and 100 kcal · mole^{-1} cannot approach the Sun closer than 0.55, 0.17, and 0.03 AU, respectively, by moving in from the periphery of the solar system on quasicircular orbits. It is shown that the particles move away from the Sun once they have attained a certain limiting distance. That implies that the particles in the inner region of the solar Fraunhofer corona cannot be supplied in finished form from the periphery of the solar system because of the Poynting–Robertson effect. The most likely and natural source of those particles would be comets with short perihelic distances responsible for the dust particles they give off falling directly into the region of the Fraunhofer corona. (auth)

5876 TUNGUS BLACK HOLE. Eardley, D. M.; Jackson, A. A. (California Inst. of Tech., Pasadena). Nature (London); 245: No. 5425, 397(19 Oct 1973).

It is stated by Eardley that the suggestion of Jackson and Ryan that the Tungus event was caused by a black hole (Nature 245:88 (1973)) contains a flaw. If the postulated interstellar population of small black holes is present in the Galaxy their mass density is $\gtrsim 10^6\ M_\odot\ pc^{-3}$, assuming an incidence of 1 per century over the Earth, which is impossible. A cosmological habitat is equally impossible. Several implausible alternatives are also mentioned. A reply by Jackson states that he does not claim an incidence of 1 per century. Jackson also states that a more serious question is why the object would have a velocity characteristic of the solar system. Can this be due to a complex perturbative encounter of the small mass with the Earth–Moon system, and would this explain the strange discrepancy in the longitude of the Moon for the period 1900 to 1920? (UK)

5877 EVIDENCE FOR SOLAR FLARE RARE GASES IN THE KHOR TEMIKI AUBRITE. Rajan, R. S.; Price, P. B. (Univ. of California, Berkeley). Nature (London) Phys. Sci.; 244: No. 138, 122-123(20 Aug 1973).

It has been suggested that the main fraction of the rare gases present in gas-rich meteorites was probably incorporated by the solar wind into the grain surfaces, which later were accreted into the meteorite breccias, and in some experiments on Khor Temiki (a gas-rich aubrite) it was shown that most of the gas was surface-correlated and resided in the superficial micron or less, consistent with the range of solar wind ions (0.05 to 0.1 μm). It has also been shown that there are "track-rich" grains in the dark portions of gas-rich meteorites, as well as the normal grains, and indications were obtained that, in addition to their exposure to solar-wind particles, these "track-rich" grains were exposed to solar-flare particles of energies up to a few MeV/nucleon for $\sim 10^4$ yr before accreting into the meteorite, and there is a correlation between the abundance of "track-rich" grains and the concentration of trapped rare gases. Ilmenite is the most retentive lunar mineral studied; there has been some diffusion loss of He, but little or no diffusion loss of Ne and heavier gases. The Khor Temiki enstatite and pyroxene seem to have suffered less diffusion loss than even the lunar minerals. Estimations are made of the percentage of solar-flare gas relative to solar-wind gas in a 200 μm grain. If there is no diffusion of solar wind into the grains, the solar-flare gases will become the major remaining component after removal of the top several microns, due to the short range of the solar-wind particles. The Khor Temiki enstatite appears to be an ideal sample in which to look for evidence of solar-flare gases. (UK)

5878 CURIUM-248 IN THE EARLY SOLAR SYSTEM. Rao, M. N.; Gopalan, K. (Tata Inst. of Fundamental Research, Bombay). Nature (London); 245: No. 5424, 304-307(12 Oct 1973).

It is stated that primitive meteorites such as carbonaceous chondrites (CC) and unequilibrated ordinary chondrites (UOC) show an anomalous fission Xe component that has a distinctly different fission spectrum from that in Ca-rich achondrites. Although the latter has been established as due to ^{244}Pu spontaneous fission, the origin of the former component is still debatable. The amount of fission Xe present in CC II–IV and some UOC has been found to be two orders of magnitude higher than that of Ca-rich achondrites, and even a maximum ^{244}Pu value could account for only 10% of CC fission Xe. Several mechanisms have been proposed to explain matters, and here an attempt is made to determine whether certain actinide isotopes with known properties could produce this excess of fission Xe in the primitive chondrites; a study of all the actinide isotopes showed that only ^{248}Cm is of interest in this connection. The α–half life and the spontaneous fission half life for this nuclide are well known, but the fission spectrum is less well known; hence a detailed examination was made of the mass distribution of several Cm and Cf isotopes in order to evaluate the fission spectrum of ^{248}Cm. A brief comment is made concerning the fine structure effects in the fission of Cm and Cf isotopes. With regard to the production of ^{248}Cm in the galaxy it seems probable that any r-process synthesis that produces heavy elements up to ^{244}Pu should also produce ^{248}Cm, the next even-even element after Pu. Furthermore, ^{248}Cm has a magic neutron configuration N = 152 and the production of this nuclide will consequently be favoured in r-process nucleosynthesis. An explanation is offered regarding the absence of excess fission gas in ordinary chondrites. These chondrites show different degrees of crystallization, probably due to their metamorphic heating after primary accretion, and it is conceivable that this heating occurred sometime after complete decay of 0.4 mg ^{248}Cm but before considerable decay of the 82 my ^{244}Pu, so that only the ^{244}Pu fission gas is found in the ordinary chondrites. The CC and UOC meteorites escape this heating, so that they retain the record of Cm presence in an earlier stage of solar system evolution. (UK)

5879 EVOLUTION OF PROMINENCES AND THEIR RELATIONSHIP TO ACTIVE CENTERS. Martin, S. F. Solar Phys.; 31: No. 1, 3-21(Jul 1973).

A necessary condition for the formation of prominences is established where components of the magnetic field of opposite sign lie juxtaposed. This condition is sometimes recognizable prior to the formation of prominences in active centers and between adjacent active centers in Hα by paths of fibrils aligned nearly end to end. Prominences are usually not found in active regions until they are about 4 days old. After this time, the number of prominences appears to be a function of the large-scale complexities in the magnetic field pattern whether these are a result of emerging flux, the merging of adjacent active centers, or the coalescing of remnant fields of active centers. Prominences may disappear by the slow or rapid flow of mass into the chromosphere or by the more violent eruptives. The formation of new active centers has been associated with the eruption of some filaments related to weak chromospheric fields. (auth)

5880 ANALYSIS OF THE 5 MIN OSCILLATORY PHOTOSPHERIC MOTION. I. A Problem in Waveform Classification. White, O. R.; Cha, M. Y. (High Altitude Observatory, Boulder, CO). Solar Phys.; 31: No. 1, 23-53(Jul 1973).

Four Mt. Wilson measurements (T > 4 h) of the photospheric motion at one point on the Sun are shown to have the characteristics of a narrow-band random process. The motion is shown to have a characteristic correlation time of 23 min and a mean power spectrum that is a smooth, single-peaked function centered at 3.4 mHz. In order to make this classification we use the analytic signal to estimate the amplitude, phase, and frequency as functions of time. The power spectrum analysis differs from the common approaches in that it uses the theoretical expression for the mean spectrum for a sequence of random pulses. Because of the random nature of the motion, we doubt the existence of more than one eigenfrequency characteristic of the photosphere as a whole. Likewise, any description of the observed motion in terms of simple deterministic functions will be inadequate for the data used here. (auth)

5881 ANALYSIS OF THE 5 MIN OSCILLATORY PHOTOSPHERIC MOTION. II. Statistical Analysis of the Oscillation as a Narrow-Band Random Process. Cha, M. Y.; White, O. R. (High Altitude Observatory, Boulder, CO). Solar Phys.; 31: No. 1, 55-74(Jul 1973).

A more objective statistical technique is applied directly to the four time series used in Paper I. The empirical probability density functions indicate that the measurements are realizations of a narrow-band random process with Gaussian statistics. This result allows quantitative statistical use of the mean autocorrelation function. For example, a characteristic correlation time is 23 min, and the motion becomes statistically uncorrelated over intervals greater than 40 min. The mean autocorrelation function is found to be free of secondary maxima that have been so troublesome in other analyses. The question raised in this paper is whether our statistical model of the motion as a Gaussian random process is also applicable to smaller regions on the order of 1″ to 2″ in size. (auth)

5882 DETERMINATION OF NOISE IN PHOTOGRAPHIC MEASUREMENTS OF SOLAR VELOCITIES AND MAGNETIC FIELDS. Brandt, P. N.; Nesis, A. (Fraunhofer Institut, Freiburg i.B.). Solar Phys.; 31: No. 1, 75-80(Jul 1973).

The noise in photographic measurements of solar velocities and magnetic fields is assumed to be essentially determined by the granularity of the film, its gamma, the scanning spot size and the parameters of the specific spectral line. A formula is derived which serves for a quantitative estimate of the rms velocity and magnetic field noise when evaluating spectrograms and spectro-

heliograms. Four typical examples are treated and show that the estimate is correct within 20%. (auth)

5883 VISIBLE SPECTRUM OF THE LOWER CORONA DURING THE TOTAL ECLIPSE OF MAY 30, 1965. Magnant-Crifo, F. (Observatoire de Meudon, France). Solar Phys.; 31: No. 1, 91-104(Jul 1973).

Spectra obtained during the May 30, 1965 eclipse by Dunn aboard the NASA aircraft are presented and analyzed. Equivalent widths and absolute intensities are given for 39 coronal lines between 3300 and 8200 Å around the west limb of the Sun at two heights. Details are given on the reduction process, and comparisons are made with other observations from the same eclipse. Some line identifications are discussed. (auth)

5884 ARCH SYSTEMS, CAVITIES, AND PROMINENCES IN THE HELMET STREAMER OBSERVED AT THE SOLAR ECLIPSE, NOVEMBER 12, 1966. Saito, K. (Tokyo Astronomical Observatory); Tandberg-Hanssen, E. Solar Phys.; 31: No. 1, 105-121 (Jul 1973).

Arch systems lying above quiescent prominences in the solar corona have long drawn the attention of eclipse observers, and such formations have been investigated since the end of the last century. Almost every eclipse photograph shows one or more arches, and in most cases the arch system is accompanied by a quiescent prominence below it and a helmet streamer above it. Also, in some cases there is a dark cavity between the arch system and the prominence. On large-scale photographs obtained at the November 12, 1966 eclipse, detailed photometry has been carried out on a formation in the corona composed of a helmet streamer straddling two multiple-arch systems each with a dark cavity and a quiescent prominence. The excess of electrons in the arches and the deficiency in the cavities are evaluated. We find that the formation of a prominence requires much more material than available in the cavity before depletion. Consequently the condensation theory of coronal matter into prominences seems to have difficulties explaining the necessary amount of matter in the cases where coronal arches—delineating magnetic field lines above the cavity—may exclude inflow of material from the corona. We comment on the low velocity of solar wind in the helmet streamer. (auth)

5885 POSSIBLE PRESENCE OF C_2 LINES IN SUNSPOT SPECTRA. Lambert, D. L. (Univ. of Texas, Austin); Mallia, E. A. Solar Phys.; 31: No. 1, 123-126(Jul 1973).

Indirect evidence against the presence of C_2 lines in umbral spectra is discussed. The dominant role of CO in the molecular equilibrium of C at umbral temperatures ensures that CN, CH and C_2 lines are formed in the same atmospheric regions. Observations of CN and CH umbral lines are in good accord with predictions based on accepted umbral model atmospheres. This implies that C_2 must follow the predictions and that it is too weak to contribute to the umbral spectrum. C_2 lines in the photosphere and penumbrae are in excellent quantitative agreement with predictions. Additional tests are proposed. (auth)

5886 SOLAR FLARE OBSERVATIONS FROM A PAIR OF MATCHED INSTRUMENTS. Ward, F.; Carnevale, R. F.; Hendl, R. G. (Air Force Cambridge Research Labs., Bedford, MA). Solar Phys.; 31: No. 1, 131-141(Jul 1973).

A pair of carefully matched telescopes and videometers were constructed and tested to determine their suitability to obtain routine standardized measurements of solar flares. Useful data were obtained from both telescopes during four flares between March 1971 and March 1972. Errors in the current international patrol are typically a factor of two. The mismatch of the areas of the four measured by these telescope systems was only 10%, indicating the extent of the possible improvement to be obtained by careful matching and intercalibration of patrol instruments. (auth)

5887 TEMPERATURE STRUCTURE OF CHROMOSPHERIC FLARES HEATED BY NONTHERMAL ELECTRONS. Brown, J. C. (Univ. of Glasgow). Solar Phys.; 31: No. 1, 143-169(Jul 1973).

Heating of the deep chromosphere by a vertically descending beam of non-thermal electrons with power-law energy spectrum, in flares, is analyzed. In lower regions of the flare, radiative losses can balance the energy input and the flare structure is described in terms of instantaneous quasisteady temperature/depth profiles. Motion of the optical flare material is at constant pressure and is constrained to be purely vertical by a vertical magnetic field. The ionization of hydrogen is determined by the same non-LTE processes as in the quiet chromosphere. Temperature profiles are obtained for a wide range of electron beam intensities and spectral indices and are discussed in terms of optical flare observations. Due to the steepness of the electron spectra, typical densities in the optical flare vary only over a narrow range, despite the diversity of beam intensities, in agreement with observation. Above a certain region, the flare material cannot attain a radiatively steady state against the electron input but evaluation of the level at which this occurs leads to an estimate of the mass of material involved in the high temperature flare plasma in this model. Results, which are again insensitive to the electron beam parameters, are found to be in satisfactory agreement with observations of the mass of flare ejecta and of soft x-ray flare emission measures. (auth)

5888 SOLAR FLARE LINE EMISSION BETWEEN 6 AND 25 A. Neupert, W. M.; Swartz, M.; Kastner, S. O. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 31: No. 1, 171-195(Jul 1973).

A list of emission lines in the spectra of solar flares between 6 Å and 25 Å has been compiled using data obtained with a KAP crystal spectrometer on the OSO-5 satellite. The emission lines have been classified according to their sensitivity to flare activity. This classification provides a method for discriminating between iron in high stages of ionization (Fe XX–Fe XXV) and lower stages (Fe XVII–Fe XIX), the lines of which are both present in the same spectral region during flares. Identifications consistent with these classifications are proposed. Anomalous intensities in the spectra of Fe XVII and Fe XX are pointed out, and implications of the observations for models of the x-ray emitting regions are discussed. (auth)

5889 THERMAL NATURE OF SOFT X-RAY FLARES. Craig, I. J. D. (University Coll., London). Solar Phys.; 31: No. 1, 197-205(Jul 1973).

Soft x-ray flare data in the wavelength range 2.6 to 10 Å are used to examine the time variation of emission measure and electron temperature. The thermal plasma parameters were derived according to a two-temperature model proposed by Herring and Craig (1973). Estimates of electron density and source volume are made by assuming conductive and radiative cooling mechanisms. It is suggested that the present observations imply a multithermal interpretation of the soft x-ray flare. (auth)

5890 QUASI-PERIODIC STRUCTURE IN SOLAR MICROWAVE BURSTS. Janssens, T. J. (Aerospace Corp., El Segundo, CA); White, K. P. III; Broussard, R. M. Solar Phys.; 31: No. 1, 207-217(Jul 1973).

High sensitivity, high time resolution recordings of microwave radio bursts show a number of periodic and quasi-periodic bursts which exhibit intervals of the order of 10 to 20 s. Some of the bursts are accompanied by simultaneous pulsations of the same interval detected in x-rays, type III-m, and extreme ultraviolet emissions. Mechanisms to explain solar radio pulsations are reviewed to see which can explain or be extended to explain these observations. (auth)

5891 SOLAR TSUNAMI. Kassinskii, V. V. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR); Krat, V. A. Solar Phys.; 31: No. 1, 219-228(Jul 1973).

Some problems of qualitative theory of solar tsunami caused by rapid magnetic disturbances are discussed. The energy of tsunami is found sufficient to produce oscillations of quiescent prominences, facular brightenings after flares and also some flares of moderate intensity. Coronal plasma satisfied the condition of incompressibility, but in the chromosphere the effects of incompressibility generally must be taken into account. Long gravity waves with the wave-length of $\lambda \geq 10^5$ km can propagate on distances comparable with solar radius without sensible damping and dissipation. The solution of tsunami problem for a model of two-component ocean consists of two long gravity waves moving with different velocity in the chromosphere and corona. The effect of encounter of tsunami with magnetic fields are discussed. (auth)

5892 MODEL OF SOLAR FLARES AND FACULAE. Piddington, J. H. (CSIRO, Sydney). Solar Phys.; 31: No. 1, 229-241(Jul 1973).

Theories of solar flares based on the storage of energy (usually as magnetic energy) in the solar atmosphere are shown to be incompatible with observational data. The sunspot energy deficit and the photospheric faculae both involve energy fluxes comparable with the flare requirement ($\approx 3 \times 10^{29}$ erg s^{-1}). Both also require a subsurface system of waves or oscillations, perhaps those discussed by Danielson and Savage and by Wilson. The flare model proposed is based on a temporary diversion of this energy carried by Alfvén waves through spots and magnetic elements or micropores; the calculated plasma perturbation velocity in the umbra is about 6 km s^{-1} for a major flare. In the atmosphere the wave energy divides into two parts to produce the cool, stationary optical flare and the particle flare. The first part is dissipated around flux tubes which are mainly horizontal in the chromosphere and which tend to concentrate along the magnetic neutral line ($B_{||} = 0$).

Each tube vibrates individually as a taut wire in a viscous fluid, to excite the fluid just outside the tube. The second part of the energy emerges along tubes mainly vertical in the chromosphere and is converted to shock waves in the corona and then to particle energy for the radio and x-ray flare and the blast wave. The model includes white-light faculae, quasi-permanent x-ray and fast-particle emissions, sympathetic flares and surges. An unambiguous test would be provided by observations of plasma motions of a few kilometers per second in spots and micro-pores. (auth)

5893 TEST FOR PLANETARY INFLUENCES ON SOLAR ACTIVITY. Dingle, L. A. (Univ. of California, Irvine); Van Hoven, G.; Sturrock, P. A. Solar Phys.; 31: No. 1, 243-246(Jul 1973).

A method due to Schuster is used to test the hypothesis that solar activity is influenced by tides raised in the Sun's atmosphere by planets. The distribution in longitude of over 1000 flares occurring in a $6\frac{1}{2}$ yr segment of solar cycle 19 was calculated, referring the longitude system in turn to the orbital positions of Jupiter and Venus. The resulting distributions show no evidence for a tidal effect. (auth)

5894 PROTON COLLISIONAL EXCITATION IN THE GROUND CONFIGURATION OF Fe^{+12}. II. Landman, D. A. (Univ. of Hawaii, Honolulu). Solar Phys.; 31: No. 1, 81-89(Jul 1973).

Improved values of the proton impact excitation cross sections at coronal energies for all the Fe^{+12} ground configuration ($3s^23p^2$) transitions are presented. These were obtained by direct computer integration of the Schroedinger equation (with the states expressed in intermediate coupling) resulting from the semi-classical Coulomb excitation theory formulation of the process. Comparison is made with previous results. The associated rate constants at coronal temperatures are given and compared with the corresponding electron impact excitation rate constants. Some cross-section values for the Fe^{+13} $3s^23p^2P_{\frac{1}{2}} \rightarrow P_{\frac{3}{2}}$ excitation are also presented. (auth)

Galaxies

Refer also to abstracts 5764, 5806, 5851, and 6196.

5895 STAR CONTRACTION AND MAGNETIC-FIELD GENERATION IN PROTOGALAXIES. Bisnovatyi-Kogan, G.S.; Ruzmaikin, A.A.; Syunyaev, R.A. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 1, 137-139 (July 1973).

A possible method is suggested for the contraction of stars and the generation of a magnetic field in a protogalaxy. The magnetic field would be produced by the dynamo effect in contracting protostars and would be adequate for transfer of excess angular momentum to the surrounding medium. Stars could thereby proceed to form in a protogalaxy having no initial magnetic field. Mass loss by stars and supernova outbursts would enrich the interstellar medium with a magnetic field, whose regular component could serve as an effective "seed" field for operation of a regular galactic dynamo. (auth)

5896 HEATING OF INTERGALACTIC GAS. Prilutskii, O.F.; Rozental', I.L. Sov. Astron.-AJ 17: No. 1, 143-144 (July 1973).

A possible mechanism for heating the intergalactic medium in the neighborhood of a cluster of galaxies is discussed. The heating would result from electron heat conduction by the hot gas in the cluster. (auth)

5897 BRIGHTEST STARS IN THE SMALL MAGELLANIC CLOUD. Osmer, P. S. Astrophys. J.; 181: No. 2, 327-348 (15 Apr 1973).

Photometric observations on the uvby system of the 169 luminous stars in Sanduleak's finding list for the SMC have been made along with Hβ measures of all his stars brighter than V = 12 and some representative fainter ones. The color–magnitude diagram shows a deficiency of very luminous stars near spectral type mid-F which is not present in the LMC. The program stars are too numerous to be evolving on a Kelvin time scale; and if the hotter evolved stars have the temperatures indicated by model atmospheres, they must be in the later stages of helium burning. The m_1 index is shown to be useful for identifying stars with Of emission features as well as Wolf–Rayet stars. The strength of the emission features, when present, in the former increases with luminosity. The distance modulus of the SMC found from the $H\beta$–c_0–M_v relation in NGC 6231 and in h and χ Per is somewhat smaller than that given by the Cepheids, in accord with other studies based on the hydrogen lines. The reddening near the supergiant stars in the SMC is variable and typically 0.10 to 0.15 mag in E_{B-V}. Hβ is generally weaker than predicted by LTE model atmospheres in the medium-temperature supergiants but is in reasonable agreement with the non-LTE calculations of Mihalas and Auer in the hottest, nonemission-line stars. Evidence is presented supporting the effective temperatures for the hotter stars which are indicated by the models. (auth)

5898 STOCHASTIC MODEL OF THE GALACTIC MAGNETIC FIELD. Kaiser, T. B. (Univ. of Maryland, College Park). Astrophys. J.; 181: No. 2, 349-357(15 Apr 1973).

Existing stochastic models of the galactic magnetic field are considered and found to suffer certain defects. A new model is proposed which overcomes faults of the previous theories while retaining their strengths. (auth)

5899 EVIDENCE FOR A SHOCK ASSOCIATED WITH THE LOCAL SPIRAL ARM. Quirk, W. J. (California Inst. of Tech., Pasadena); Crutcher, R. M. Astrophys. J.; 181: No. 2, 359-362 (15 Apr 1973).

The "cold cloud" of Riegel and Crutcher is probably a region of high gas density caused by a shock induced by the gravitational field of the local spiral arm, at an inclination angle of 5 to 8°. (auth)

5900 INTERSTELLAR RADIATION DENSITY BETWEEN 1250 AND 5250 Å. Witt, A. N.; Johnson, M. W. (Univ. of Toledo). Astrophys. J.; 181: No. 2, 363-368(15 Apr 1973).

Using a model distribution of stars and dust, the interstellar radiation density was calculated in the solar vicinity. The detailed wavelength dependence of interstellar extinction and of the albedo of the interstellar grains was taken into account, and the transformation of the stellar luminosity function was based on OAO-2 photometry. Excellent agreement was found between the calculations and empirical data determined by Lillie, but a radiation density higher by about a factor of two compared to earlier calculations by Habing for the wavelength range from 1000 to 2000 Å is predicted. A very steep rise in the spectrum of the radiation field toward shorter wavelengths in the interval 2000 to 1500 Å was also found. This rise, if characteristic for galaxies in general, may in part explain the high ultraviolet fluxes observed from galaxies with OAO-2. The revised shape of the spectrum of the interstellar radiation field is expected to be of consequence in studies of the ionization equilibrium of interstellar clouds. (auth)

5901 LABORATORY MICROWAVE SPECTRUM OF METHYLAMINE. Takagi, K.; Kojima, T. (Toyama Univ., Gofuku, Japan). Astrophys. J.; 181: No. 2, L91-L93(15 Apr 1973).

Observed laboratory frequencies of CH_3NH_2 are listed. (auth)

5902 I4329A: AN EXTREME SEYFERT GALAXY. Disney, M. J. (Australian National Univ., Canberra). Astrophys. J.; 181: No. 2, L55-L60(15 Apr 1973).

The southern spiral I4329A is found to be the most extreme Seyfert yet discovered. Hα is 13,000 km s^{-1} wide, and f(Hβ) is 7×10^{42} ergs s^{-1}, which approaches that from the QSOs even if they are at cosmological distances. The hydrogen line profiles rule out electron scattering as the broadening mechanism, but there are differences of profile from line to line which are not understood. (auth)

5903 SEARCH FOR Hα EMISSION FROM INTERSTELLAR CLOUDS. Reynolds, R. J. (Goddard Space Flight Center, Greenbelt, MD); Scherb, F.; Roesler, F. L. Astrophys. J.; 181: No. 2, L79-L82(15 Apr 1973).

Upper limits were determined for the emission measures of five interstellar "clouds." These limits are significantly smaller than the emission measures predicted by a recent model in which the variation in the column-density ratio Na^0/Ca^+ among interstellar clouds is attributed to differences in the temperature, density, and hydrogen ionization fraction of the clouds. (auth)

5904 INTERSTELLAR DUST IN THE RHO OPHIUCHI DARK CLOUD. Carrasco, L. (Univ. of California, Berkeley); Strom, S. E.; Strom, K. M. Astrophys. J.; 182: No. 1, 95-109(15 May 1973).

The dark cloud near ρ Oph is shown to be an ideal region for studying several characteristics of the dust component of the interstellar medium. Infrared and optical photometry and measurements of the wavelength dependence of polarization suggest that the grains are larger in the higher-density regions of the ρ Oph cloud. It is argued that this size increase results from depletion of heavy elements from the gas onto the grains. Given the observations, the adopted depletion model predicts an age for the cloud of $t \geq 7 \times 10^5$ years/ξ_a, where ξ_a is the probability per grain-atom collision that a heavy-element atom will stick to the grain. From independent estimates of the cloud age, the plausible range for ξ_a is $0.1 \leq \xi_a \leq 1$. This result suggests that heavy-element depletion is a fairly efficient process and can be important in determining the thermal balance in interstellar clouds. The ob-

served polarization is highest for the most heavily obscured stars, which suggests that the grains are well aligned even in the densest observable regions of the cloud. A magnetic field appears to be the most likely source of grain alignment, and at the high densities prevailing near the cloud center, fields as high as several times 10^{-4} gauss may be required. (auth)

5905 OBSERVATIONS OF GAS MOTIONS IN AND NEAR THE CENTRAL CAVITY OF THE ROSETTE NEBULA. Smith, M. G. Astrophys. J.; 182: No. 1, 111-120(15 May 1973).

Emission-line profiles from the central regions of the Rosette Nebula show that from a dynamical point of view the H II region can be split into two distinct regions as predicted, qualitatively at least, by theory. The outer parts of the nebula are once again shown to lack significant large-scale motions. The central region consists of a shell of ionized material, probably expanding at a velocity of about 20 km s^{-1}. The symmetry of the gas motions about the central cavity and estimates from models by Dyson are consistent with the conclusion that mass loss from the central cluster of stars is the source of energy required to drive the observed supersonic motions. (auth)

5906 MARINER 9 ULTRAVIOLET SPECTROMETER EXPERIMENT: INTERSTELLAR ABSORPTION AT LYMAN ALPHA IN OB STARS. Bohlin, R. C. (Univ. of Colorado, Boulder). Astrophys. J.; 182: No. 1, 139-145(15 May 1973).

Column densities of neutral hydrogen N_H toward 10 stars were derived from spectra obtained with the ultraviolet spectrometer (UVS) on the Mariner 9 Mars orbiter. The 7.5 Å resolution was sufficient for a direct analysis of the data without assumptions about the strength of the lines that blend with the Lα profile at lower resolution. The deduced values of N_H were systematically lower than those derived from OAO-2 data. (auth)

5907 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. VI. Extinction by Grains at Wavelengths Between 1200 and 1000 Å. York, D. G.; Drake, J. F.; Jenkins, E. B.; Morton, D. C.; Rogerson, J. B.; Spitzer, L. (Princeton Univ., NJ). Astrophys. J.; 182: No. 1, L1-L6 (15 May 1973).

Extinction curves for the interstellar material are extended from 9 to 10 μ^{-1} (1100 to 1000 Å) for the reddened stars ζ Oph, ζ Per, ξ Per, and α Cam. Good agreement with earlier results is obtained from 7.5 to 9 μ^{-1}. In all cases, the extinction continues to increase in the far-ultraviolet. For ζ Oph and ζ Per, the increase of one in inverse micron units corresponds to an increase in extinction of about 3 mag, for an E(B−V) of one. The qualitative result is that smaller particles must be added to the general mix assumed for the interstellar material for all four stars. The feature expected for graphite at 1030 Å does not stand out above the generally rising extinction, except possibly in α Cam. (auth)

5908 REDSHIFTS FOR 51 GALAXIES IDENTIFIED WITH RADIO SOURCES IN THE 4C CATALOG. Sargent, W. L. W. (California Inst. of Tech., Pasadena). Astrophys. J.; 182: No. 1, L13-L15(15 May 1973).

Redshifts are given for 51 galaxies identified by Olsen and by Hazard and Jauncey with radio sources in the 4C catalog between +20° and +40° declination. These objects do not represent a complete sample. (auth)

5909 RADIO OBSERVATIONS OF CHAINS AND GROUPS OF GALAXIES. Sulentic, J. W.; Kaftan-Kassim, M. A. (State Univ. of New York, Albany). Astrophys. J.; 182: No. 1, L17-L19 (15 May 1973).

Several chains and groups of galaxies were observed at low frequencies using the Arecibo radio telescope. No excess radiation over normal galaxies was detected. (auth)

5910 SEARCH FOR EXTRAGALACTIC OBJECTS IN THE GENERAL CATALOG OF VARIABLE STARS. Bond, H. E. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 181: No. 1, L23-L24(1 Apr 1973).

As part of a search for optically variable extragalactic objects, some 700 variables listed in the General Catalog of Variable Stars were examined on the Palomar Sky Atlas prints. Two objects, X Comae and V1102 Cygni, have the appearance of compact galaxies, and, together with such previously discovered objects as V395 Herculis and Zw 0039.5 + 4003, define a class of radio-quiet, optically variable galaxies. (auth)

5911 INFRARED AND RADIO OBSERVATIONS OF THE NUCLEUS OF NGC 253. Becklin, E. E. (California Inst. of Tech., Pasadena); Fomalont, E. B.; Neugebauer G. Astrophys. J.; 181: No. 1, L27-L31(1 Apr 1973).

An extended nuclear core to NGC 253 was mapped in both the infrared and radio wavelengths. The 10″ core showed a large 10- and 20-μ flux and a relatively flat radio spectrum. The infrared is conjectured to come from thermal reradiation from dust grains. (auth)

5912 MARINER 9 ULTRAVIOLET SPECTROMETER EXPERIMENT: UPPER LIMITS ON THE LYMAN-ALPHA FLUX FROM CLUSTERS OF GALAXIES. Bohlin, R. C. (Univ. of Colorado, Boulder); Henry, R. C.; Swandic, J. R. Astrophys. J.; 182: No. 1, 1-7(15 May 1973).

Data from the ultraviolet spectrometer on the Mariner 9 Mars orbiter have been used to set upper limits on the redshifted Lα flux from the Perseus and Pegasus I (NGC 7619) clusters of galaxies. The limit for the Perseus cluster implies that the temperature of the intergalactic gas required for gravitational binding must be greater than 10^5 °K, if it exists. A less severe limit is set for the Pegasus I cluster. (auth)

5913 SURVEY OF RADIO RECOMBINATION LINES TOWARD THE GALACTIC CENTER. Lockman, F. J. (Univ. of Massachusetts, Amherst); Gordon, M. A. Astrophys. J.; 182: No. 1, 25-39(15 May 1973).

Observations at 14 positions in the direction of the galactic center region show H159α (1.621 GHz) hydrogen recombination lines over an extended area. The lines do not originate under conditions of LTE. Comparison of one of the spectra with a neutral-hydrogen absorption profile taken in the same direction shows a coincidence of features. The data is best interpreted as emission from a region with electron temperature of 20°K and an electron density of 3 cm^{-3} lying along the line of sight to the galactic center. This model is also consistent with the observations of diffuse H157α and H166α line emission from the inner regions of the Galaxy. (auth)

5914 ABSENCE OF FORMALDEHYDE RADIATION TOWARD COLD REGIONS OF THE GALACTIC PLANE: FURTHER INVESTIGATION. Gordon, M. A. (National Radio Astronomy Observatory, Green Bank, WV); Hoeglund, B. Astrophys. J.; 182: No. 1, 41-44(15 May 1973).

A survey of three 1° × 1° regions, located on the galactic plane at galactic longitudes of 48, 70, and 110°, fails to show the 6-cm line of H_2CO either in absorption or emission to a peak-to-peak noise limit of 0.15°K in antenna temperature. The results extend those of Gordon and Roberts, which covered 0.2 square degrees, to 3 square degrees. The results are considered in terms of a crude distribution function of dust clouds. (auth)

5915 RADIO DETECTION OF A GIANT DUST COMPLEX IN THE PERSEUS ARM. Hoeglund, B. (Onsala Space Observatory, Sweden); Gordon, M. A. Astrophys. J.; 182: No. 1, 45-54 (15 May 1973).

An optically invisible giant dust complex has been detected through observations in H_2CO, OH, and H I. Its distance is about 4400 pc and the dimensions roughly 38 × 13 pc. Derived column densities are 3.8×10^{13} for H_2CO, 1×10^{14} for OH, and 2.3×10^{19} cm^{-2} for H I. The plausibility of these values is discussed. (auth)

5916 JHKL COLOURS OF GALAXIES. Glass, I. S. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 164: No. 2, 155-168(1973).

JHKL photometry has been attempted for 27 southern galaxies, mostly barred spirals. In contradistinction to the work of Johnson and others, the values of K−L for ostensibly normal galaxies were often found to be much greater than those for normal stars. The general colors of galaxies in this spectral region are discussed, and their fluxes are compared with those obtained at other wavelengths. Two Seyfert galaxies were measured in the infrared for the first time and shown to possess unexceptional colors. A detailed description of the photometer is included. (auth)

5917 CONTRACTION OF STELLAR SYSTEMS. Takarada, K. (Kyoto Technical Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1567-1573(May 1973).

Stellar systems are included which include the comparable amount of gas with stars. The condition for stellar systems to contract due to the dissipation of its kinetic energy through the direct and gravitational interactions between stars and gases is obtained. For a stellar system to contract within a Hubble time, it must be compact initially, and accordingly, the gas density is high. The gas cannot remain interstellar for a Hubble time and the stellar system does not contract unless the system is extremely compact initially. In conclusion, it is impossible for a stellar system to contract from the stage where the dissipation of stellar kinetic energy is ineffective to the stage where it is effective. (auth)

5918 HEATING OF THE INTERSTELLAR GAS. de Freitas Pacheco, J. A. (Univ., Sao Paulo, Brazil). Rev. Brasil. Fis.; 2: No. 2, 29-32(Aug 1972).

Supposing that the flux measured by Bunner et al. (1971) at 0.26 keV in the galactic plane is due to x-ray sources, it is shown

that the energy-input rate of these sources is not enough to heat the interstellar gas. (auth)

5919 OBSERVATIONS OF NEUTRAL HYDROGEN NEAR THE GALACTIC CENTER. Wrixon, G. T. (Bell Telephone Labs., Inc., Holmdel, NJ); Sanders, R. H. Astron. Astrophys., Suppl. Ser.; 11: No. 3, 339-345(Sep 1973).

Results of a high-resolution, high-sensitivity survey of neutral hydrogen in the region $-3° \leq l \leq +3°$, $-3° \leq b \leq +3°$ are presented in the form of contour diagrams of antenna temperature as a function of galactic longitude and velocity. (auth)

5920 PHOTOELECTRIC UBV PHOTOMETRY IN SOME MILKY WAY FIELDS. Wramdemark, S. (Univ. of Lund, Sweden). Astron. Astrophys., Suppl. Ser.; 11: No. 3, 365-397(Sep 1973).

Results of photoelectric UBV photometry are presented for 334 stars, situated in Milky Way fields in Cyg and Gem-Ori. (auth)

5921 OPTICAL POSITIONS OF BRIGHT GALAXIES. II. Gallouet, L; Heidmann, N.; Dampierre, F. (Observatory, Paris). Astron. Astrophys., Suppl. Ser.; 12: No. 1, 89-125(Oct 1973).

The optical positions of the 821 galaxies of the Reference Catalogue of Bright Galaxies by G. and A. de Vaucouleurs, in the declination zone 26° to 90°, are given with an accuracy of a few seconds of arc, together with two small nearby reference stars, for each galaxy, to locate the chosen center. (auth)

5922 UBV SEQUENCES IN SIX OF KAPTEYN'S SELECTED AREAS. Haeggkvist, L. (Uppsala Astronomical Observatory). Astron. Astrophys., Suppl. Ser.; 12: No. 1, 85-88(Oct 1973).

Photoelectric UBV sequences in six of Kapteyn's Selected Areas (nos. 4, 32, 55, 58, 80, and 81) are presented. (auth)

5923 OBSERVABILITY OF CIRCULARLY POLARIZED OPTICAL RADIATION FROM CERTAIN COSMIC OBJECTS. Gnedin, Yu. N.; Dolginov, A. Z.; Silant'ev, N. A. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 976-979(1973).

Translated from Astron. Zh.; 49: No. 6, 1205-1210(1972).

Circular polarization and oscillations in the plane of linear polarization ("Faraday pulsations") can arise when radiation passes through an anisotropic dust medium, provided that the direction of preferential vibration of the electric vector of the incident radiation forms an angle different from zero at $\pi/2$ with the plane containing the line of sight and the direction of orientation of the scattering medium. A comparison between the observed and computed circular polarization of the optical radiation of the Crab Nebula indicates that the interstellar dust is aligned at an angle of about 18° relative to the galactic plane. There are several types of galactic and extragalactic objects which might exhibit appreciable circular polarization and Faraday pulsations in the plane of vibration of the electric vector. (auth)

5924 DEVELOPMENT OF ROTATION IN GALAXIES IN THE NONLINEAR THEORY OF GRAVITATIONAL INSTABILITY. Doroshkevich, A. G. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 986-990(1973).

Translated from Astron. Zh.; 49: No. 6, 1221-1228(1972).

The generation of vortical velocities and the origin of rotation in cosmic objects is analyzed in terms of the nonlinear theory of gravitational instability. Since the development of irrotational perturbations will tend to produce shock waves, the conditions of the Thomson theorem will be violated, and vortical motions will become possible. Estimates are obtained for the parameters of the gas compressed by such a shock, and for the resulting vortical velocities and angular momentum of a protogalaxy. The analysis implies that: 1) At the time of their formation, cluster galaxies have approximately coplanar angular-momentum vectors; 2) the specific angular momentum of cluster galaxies increases with distance from the cluster center; 3) the specific angular momentum of galaxies at a given distance from the cluster center decreases as the mass of the cluster increases. (auth)

5925 EIGENFREQUENCY SPECTRUM OF A FINITE-RADIUS GRAVITATING CYLINDER OF FREE PARTICLES. Bisnovatyi Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 997-1002(1973).

Translated from Astron. Zh.; 49: No. 6, 1238-1248(1972).

The frequency spectrum is calculated for an infinitely long, homogeneous gravitating cylinder of finite radius consisting of free particles. The distribution function, $f(v_z)$, contains streams of different densities. It is shown that the equilibrium state of such a cylinder is unstable against surface, two-stream, and cyclotron modes, although the growth rate of the surface waves is exponentially small if the thermal spread of the particles is large. The instability regions are found for the two-stream and cyclotron modes and the eigenfrequencies and growth rates are calculated for different values of the parameters. (auth)

5926 DETECTION OF HOT GAS IN THE COMA CLUSTER OF GALAXIES. Parilskii, Yu. N. (Special Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 6, 1048 (1973).

Translated from Astron. Zh.; 49: No. 6, 1322-1323(1972).

The scattering of cold primordial photons by hot gas in clusters of galaxies can produce a "dark spot" in the 3°K background radiation. This effect has been detected in the direction of the Coma cluster. (auth)

5927 FAR-INFRARED OBSERVATIONS OF GALACTIC NUCLEI. Harper, D. A. Jr. (Univ. of Chicago); Low, F. J. Astrophys. J.; 182: No. 2, L89-L93(1 Jun 1973).

M82 (NGC 3034) and NGC 253 were detected at wavelengths between 27 and 125 μ. Their respective 3 to 3000 μ luminosities were 5×10^{10} $L_\odot$ and 3×10^{10} $L_\odot$. A 2 σ_m upper limit of 760×10^{-26} W m^{-2} Hz^{-1} was established for the 110-μ flux from NGC 1068. (auth)

5928 FORMATION OF THE HD MOLECULE IN THE INTERSTELLAR MEDIUM. Watson, W. D. (Univ. of Illinois, Urbana). Astrophys. J.; 182: No. 2, L73-L76(1 Jun 1973).

Ion-molecule, isotope exchange reactions in the interstellar gas that can form HD preferentially in comparison with H_2 are examined. Emphasis is placed upon conditions that are representative of interstellar clouds in which the unexpectedly large HD/H_2 abundance ratio has recently been observed. Enhanced abundances of the observed magnitude for HD will be produced if the $D^+ + H_2 \rightarrow HD + H^+$ cross section has a value typical of ion-molecule reactions. Preliminary measurements do indicate that this cross-section is large enough to produce enhancements greater than $\sim 10^2$ in the observed HD/H_2 ratio. (auth)

5929 PECULIAR GALAXY NGC 523. Chincarini, G. (Univ. of Texas, Austin); Heckathorn, H. M. Publ. Astron. Soc. Pac.; 85: No. 507, 568-572(Oct 1973).

Electrographic and spectroscopic observations were obtained of the peculiar galaxy NGC 523. The observations suggest that the pecularities of the system result from a close encounter by two dwarf galaxies, with tidal interaction responsible for the formation of the galactic bridge and tails. (auth)

5930 SPIRAL GALAXY ORIENTATION IN THE VIRGO CLUSTER. Thompson, L. A. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 85: No. 507, 528(Oct 1973).

On the assumption that the direction of a galaxy's spiral winding defines the direction of its rotational angular momentum vector, 101 spiral galaxies in the area of the Virgo cluster were used to analyze the distribution of rotational angular momentum. The main body of the cluster is very isotropic, but the "southern wing" shows a marginal anisotropy. (auth)

5931 X-RAY EMISSION FROM RICH CLUSTERS OF GALAXIES. Gursky, H. (American Science and Engineering, Cambridge, MA). Publ. Astron. Soc. Pac.; 85: No. 507, 493-502 (Oct 1973).

Topics considered include the existence of cluster sources, detailed properties of the x-ray sources, related characteristics of clusters of galaxies, and model for the x-ray emission. (WDM)

5932 DETERMINATION OF THE POTENTIAL ENERGY OF A GRAVITATIONAL SYSTEM WITH SPHEROIDAL SYMMETRY. Afanas'ev, V. L. (Kiev State Univ.). Astrophysics (Engl. Transl.); 7: No. 3, 281-285(1971).

Translated from Astrofizika; 7: No. 3, 481-487(1971).

Ambartsumyan's "strip" method is generalized to systems with spheroidal symmetry. Equations are obtained which can be used to compute the mass–luminosity ratio for two elliptic galaxies NGC 4406 ($f/f_\odot = 46$) and NGC 4486 ($f/f_\odot = 48$). The estimates given are in satisfactory agreement with the results of other authors. (auth)

5933 SPECTROSCOPIC STUDY OF LUMINOUS GALACTIC NUCLEI. Khachikyan, E. Ya.; Weedman, D. W. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 3, 231-240(1971).

Translated from Astrofizika; 7: No. 3, 389-406(1971).

Spectroscopic observations of a sample of galactic nuclei from the lists of Markaryan and Seyfert are presented in order to consider the nature of nuclei with broad emission lines. It is found from photographic spectrophotometry and emission line profiles that such galaxies can be consistently classified into two classes: objects like NGC 5548 that are found to have small, dense nuclei containing low velocity gas and objects like NGC 1068 with larger nuclei containing gas of lower density but higher velocity. The observational data favors broadening by electron scattering for the Balmer lines in the first class, and the absolute luminosity in $H\beta$ is generally greater in the first class than in the second. From

the extreme spectroscopic and morphological similarity of all galaxies in the second class, it is concluded that the outflow of gas from the nucleus has affected the structure of the entire galaxy. (auth)

5934 LARGE-SCALE STRUCTURAL CHARACTERISTICS AND PHOTOMETRY OF NGC 3031 DETERMINED FROM EQUIDENSITY CURVES. Hoegner, W.; Kadla, Z.; Richter, N.; Strugatskaya, A. (Karl-Schwarzschild-Observatorium Tautenburg, Ger.). Astrophysics (Engl. Transl.); 7: No. 3, 241-245(1971).

Translated from Astrofizika; 7: No. 3, 407-415(1971).

The method of integral equidensity curves was applied for determining the large-scale structure of the galaxy NGC 3031. Altogether 49 equidensity curves were obtained from four UBVR plates taken with the 2-m telescope of the Tautenburg Observatory. The axial ratio and position angle of the major axis in dependence on the apparent distance to the center of the galaxy were derived. These dependences are the same in all the investigated wavelength regions. The relative surface brightness in UBV in dependence on the semi-major axis was determined by means of a photographic wedge printed on the original photographs. A comparison with photoelectric measurements in V and B enabled a determination of the zero-point and the apparent surface brightness. (auth)

5935 TIME VARIATIONS OF THE VELOCITY DISTRIBUTION DUE TO PHASE MIXING. Byl, J.; Ovenden, M. W. (British Columbia Univ., Vancouver, Can.). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 289-294(1973).

Using first-order epicyclic theory, the phase mixing of initial conditions of a stellar sub-population in an otherwise axisymmetric, infinitesimally thin galaxy is examined. The parameters of the velocity distribution are found to oscillate about the equilibrium values and are gradually damped. Since the time for phase mixing is $\sim 10^9$ yr and since the vertex deviation can oscillate, due to mixing, with large amplitudes, phase mixing may be important in examining the large vertex deviations observed for young stars. (auth)

5936 INTERPRETATION OF FAR INFRA-RED EMISSION FROM INTERSTELLAR GRAINS. Caroff, L. J.; Petrosian, V.; Salpeter, E. E.; Wagoner, R. V.; Werner, M. W. (National Aeronautics and Space Administration, Moffett Field, CA). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 295-302(1973).

The Kramers–Kronig relations are applied to grains in the interstellar medium and it is found that the recent uv, visual, and infrared extinction curves provide marginal evidence against silicates as the major cause of this extinction. In the far infrared, grains contribute little to the extinction, but can be observed in thermal emission. It is shown that the far infrared emission from grains in a given bandwidth sets a lower limit to the grain temperature. From observed intensities from the galactic plane at 100 μ and from Orion at 350 μ minimum grain temperatures are found which are larger than the observed brightness temperature. The emission and extinction data can be used together to constrain the allowable range of parameters for the grains. (auth)

5937 SEARCH FOR INTERSTELLAR MOLECULAR LINES IN THE FREQUENCY RANGE 8.6 to 9.2 GHz. Batchelor, R. A.; Brooks, J. W.; Godfrey, P. D.; Brown, R. D. Aust. J. Phys.; 26: No. 4, 557-560(Aug 1973).

An unsuccessful search was made in the directions of Sagittarius B2, Sagittarius A, and Orion A for molecular lines of formyl, pyridine, formaldehyde, acrolein, and formamide in the frequency range 8.6 to 9.2 GHz. The failure to detect the formyl line in particular provides evidence about the possible modes of formation of interstellar formaldehyde. (auth)

Cosmology

Refer also to abstract 6196.

5938 ON THE TEMPERATURE OF THE MICROWAVE BACKGROUND RADIATION AT A LARGE REDSHIFT. Bahcall, J.N.; Joss, P.C. (Institute for Advanced Study, Princeton, New Jersey, 08540); Lynds, R. Astrophys. J. Lett. 182: No. 3, L95-L98 (15 June 1973).

It is shown that the temperature of the microwave background radiation at a redshift of the order of 2.5 is certainly less than 200° K and probably less than 45° K. Further detailed studies of the absorption spectra of large-redshift quasars can improve these limits. (auth)

5939 COMPACTNESS CRITERION FOR THE FORMATION OF AVERAGED TRAPPED SURFACES IN GRAVITATIONAL COLLAPSE. Hartle, J.B.; Wilkins, D.C. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. Lett. 31: No. 1, 60-63 (2 July 1973).

An average trapped surface is defined as a closed two-surface with the property that the area of the wave fronts formed by light rays emitted in the orthogonal inward and outward directions are both decreasing. A sufficient criterion is given for the formation of average trapped surfaces in a general gravitational collapse. The criterion has the qualitative form that if a given amount of matter is compacted into a sufficiently small region, then an average trapped surface must be formed. In the case of nearly spherically symmetric gravitational collapse, it is shown that average trapped surfaces always form to second order in the perturbations of spherical symmetry. (auth)

5940 FINE-SCALE ANISOTROPY OF THE MICROWAVE BACKGROUND: AN UPPER LIMIT AT $\lambda = 3.5$ MILLIMETERS. Boynton, P. E. (Univ. of Washington, Seattle); Partridge, R. B. Astrophys. J.; 181: No. 2, 243-253(15 Apr 1973).

Using the 36-foot NRAO telescope at $\lambda = 3.5$ mm, an upper limit of 0.0043°K was set, with 90 percent confidence, on the fluctuations in the cosmic microwave background. The angular scale of the measurement was ~80″. If discrete sources produce all of the microwave background, their number must exceed ~0.35 Mpc^{-3}. (auth)

5941 COMPTON MODELS OF THE ISOTROPIC X-RAY BACKGROUND. Brecher, K. (Univ. of California, San Diego). Astrophys. J.; 181: No. 2, 255-259(15 Apr 1973).

It is shown that the spectral shape of the x-ray flux arising from Compton scattering of fast electrons on the microwave background radiation, contrary to a recent assertion, is not inconsistent with present observations of the isotropic x-ray background. (auth)

5942 DEFINITION REST IN EMPTY UNIVERSES. von Hoerner, S. Astrophys. J.; 181: No. 2, 261-268(15 Apr 1973).

Using two test particles, a definition of rest is given which holds for any type of curved 3-space, empty or not. A two-rocket experiment is described which establishes the absolute rest frame [and measures k, R_0, $(d^2R/dt^2)_0$] without regard to any matter or background radiation. A cosmic twin paradox is mentioned. In general relativity, the model with $\sigma_0 = q_0 = \Lambda = 0$ (Milne) is empty and force-free as well, but it still allows the definition of absolute rest. (auth)

5943 COSMIC TURBULENCE AND THE ORIGIN OF GALAXIES. Jones, B. J. T. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Astrophys. J.; 181: No. 2, 269-294(15 Apr 1973).

It is shown that, contrary to previous assertions, turbulence in the Universe cannot be supported against viscous decay after the epoch t_{eq} when the energy densities of matter and radiation are equal. Indeed, the decay is so rapid that for cosmological models with density parameter $\Omega h^2 > \Omega_m h^2 = 0.06$ the turbulent eddies cannot develop large density variations after the epoch of recombination. This value of $\Omega_m h^2$ is determined by making rather conservative estimates for the rate of decay of the turbulence, and it is not unlikely that future developments will lower its value still further. The problem of galaxy formation in cosmological models with $\Omega h^2 < \Omega_m h^2$ is also considered. It is shown there that a satisfactory picture for the origin of spiral galaxies can be produced, but only if the process of condensation of material into galaxies is very efficient. The theory has difficulty in accounting for the origin of the elliptical galaxies if these are systems of low specific angular momentum. An alternative theory of galaxy formation, based on the dissipation of strong turbulence of t_{eq}, is presented. In this theory, galaxies form from density perturbations which are developed at t_{eq} as a result of the decay of turbulence, and the problems of the turbulence theories are thereby avoided. The theory has only one arbitrary parameter, Ωh^2 (which is at least one less than in other theories of galaxy formation presented so far), and for agreement with observation, $\Omega h^2 \sim 0.25$. With this value, it is possible to explain the typical masses and angular momenta of large galaxies, and also their present mean densities. (auth)

5944 SEARCH FOR GRAVITY WAVES BY MEANS OF THE EARTH EIGEN VIBRATIONS. Tuman, V. S. (Stanislaus State Coll., Turlock, CA). Gen. Relativity Gravitation; 4: No. 4, 279-287(1973).

From international conference on gravitation and relativity; Copenhagen, Denmark (Jul 1971).

It was observed that in certain regions of the spectrum, even eigen vibrations of the earth with quadrupole and multipole moments have higher energy content than odd eigen vibrations. Since it is difficult to explain this parity effect as being due to an internal source, it is speculated that the effect is caused by intense gravitational radiation. In order to maintain the parity structure, it is estimated that gravitational radiation would have to provide energy

to the earth's eigen vibrations at a rate of about 10^9 to 10^{10} ergs/sec. The necessary gravitational flux density, however, has not yet been estimated, since the cross sections of these eigen vibrations are unknown. At the moment, further investigation is needed to determine whether the anomalous parity structure appears occasionally or is present continuously. (UK)

5945 COLLAPSE OF A NULL FLUID. Morgan, T. A. (California Inst. of Tech., Pasadena). Gen. Relativity Gravitation; 4: No. 4, 273-278(1973).

An exact cylindrically symmetric solution of Einstein's gravitational field equations is given for a null fluid imploding radially along an infinite axis. This solution plays an important role in the late stages of collapse of a long cylinder of matter. One might expect that self-gravitational effects due to the increasingly relativistic mass of the collapsing matter would create arbitrarily large gravitational fields. It is shown, however, that in the null-fluid approximation the metric is everywhere regular. The solutions which are obtained obey a principle of linear superposition, and thereby give the general solution for systems with whole-cylinder symmetry which consist of a null fluid and massless meson waves. (UK)

5946 ON PERTURBATIONS OF A KERR BLACK HOLE. Wald, R.M. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). J. Math. Phys. (N.Y.) 14: No. 10, 1453-1461 (Oct 1973).

Gravitational perturbations of a Kerr black hole are analyzed using the Newman–Penrose formalism. Teukolsky has obtained decoupled wave equations for the perturbed Weyl tensor components ψ_0 and ψ_4. In this paper we prove that for well-behaved perturbations ψ_0 and ψ_4 uniquely determine each other, i.e., $\psi_0 = 0$ if and only if $\psi_4 = 0$. Then we solve the Kerr perturbation equations with $\psi_0 = \psi_4 = 0$ and show that the only well-behaved solutions are the trivial perturbations to other Kerr solutions via an infinitesmal change in the mass and angular momentum parameters. These results prove that either of the quantities ψ_0 or ψ_4 alone uniquely specifies the nontrivial part of a gravitational perturbation of a Kerr black hole. Consequences of this result are discussed. (auth)

5947 ANGULAR-DIAMETER–RED SHIFT RELATION FOR RICH CLUSTERS OF GALAXIES. Paal, G. (Konkoly Observatory, Budapest). Astrophysics (Engl. Transl.); 7: No. 3, 257-268 (1971).

Translated from Astrofizika; 7: No. 3, 435-456(1971).

A simple method of determining a characteristic size of cluster of galaxies was developed and applied to all rich clusters with known redshifts to establish a new observational relation for cosmology: an apparent-size–redshift relation. Empirical evidence was obtained suggesting the presence of a large-scale inhomogeneities in the distribution of clusters of galaxies, the evolution of the clusters, the reality of the expansion of the universe, and the possibility of correcting the value of the Hubble "constant" as well as deceleration parameter of the universal expansion. (auth)

5948 ASTRONOMICAL OBJECTS EMBEDDED IN MATTER. II. Light Tracks. Burman, R. R. J. Proc. Roy. Soc. N. S. W.; 105: 9-14(1972).

This paper deals with the space–time region, outside a static spherically symmetric object, occupied by a continuous distribution of matter. Integrals of the Einstein–Maxwell equations, with one of the functions in the metric left arbitrary, are used to investigate light tracks; conditions for the existence of circular photon orbits are obtained. Particular attention is paid to the case in which the external matter is homogeneous and the central object is uncharged. (auth)

5949 ASTRONOMICAL OBJECTS EMBEDDED IN MATTER. I. External Metrics. Burman, R. R. J. Proc. Roy. Soc. N. S. W.; 105: 3-8(1972).

This series deals with bodies, which may be charged, embedded in matter which has density varying with the radial coordinate. In this Part, the external material is represented by uncharged incoherent matter; static spherically symmetric integrals of the Einstein–Maxwell equations are obtained with one of the functions in the metric left arbitrary. For the case of homogeneous external matter, one integral is obtained in closed form and expansions of the other integral are given which are valid near the central body, if it is uncharged, or well away from it; for an uncharged central body, the second integral also is expressed in closed form. (auth)

5950 MOTION OF PARTICLES IN CONFORMALLY FLAT SPACE–TIMES. Burman, R. R. J. Proc. Roy. Soc. N. S. W.; 105: 1-2(1972).

The Papapetron–Pirani equation of motion for a spinning particle is specialized to conformally flat space–times. In de Sitter space, this equation, and the DeWitt–Brehme–Hobbs equation of motion for a nonspinning charged particle in an electromagnetic field with radiation reaction allowed for, have the same forms as in special relativity. (auth)

Planetary Phenomena

Refer also to abstracts 5784, 5827, and 6196.

5951 (COO-3236-6, pp 26-28) SEARCH FOR EXTINCT NATURAL RADIOACTIVITY OF ^{146}Sm. Lin, C. C. 31 May 1973.

In nuclear chemistry and geochemistry research.

Procedures for determining ^{142}Nd/^{146}Nd, ^{143}Nd/^{146}Nd, and ^{144}Sm/^{146}Nd ratios in 1g samples (meteorites and lunar samples) to 0.1% accuracy are outlined. (CES)

5952 SOLAR WIND–MERCURY ATMOSPHERE INTERACTION: DETERMINATION OF THE PLANET'S ATMOSPHERIC DENSITY. Siscoe, G.L.; Mukherjee, N.R. (Space Sciences Department, McDonnell Douglas Astronautics Company, West Huntington Beach, California, 92647). J. Geophys. Res. 78: No. 19, 3961-3964 (1 July 1973).

It is shown that the atmosphere of Mercury can be detected and possibly its density determined from solar wind data such as those that will be obtained with the Mariner-Venus-Mercury spacecraft during the flyby mission of 1974. (WDM)

5953 JUPITER'S RADIATION BELTS AND THE SWEEPING EFFECT OF ITS SATELLITES. Mead, G.D. (Laboratory for Space Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771); Hess, W.N. J. Geophys. Res. 78: No. 16, 2793-2811 (1 June 1973).

Jupiter's electron and proton radiation belts are analyzed, with particular reference to the sweeping effect of its five inner satellites, located deep within its magnetosphere. The characteristics of trapped electrons and protons with a magnetic moment of 50 Mev/G, considered typical at Jupiter, are calculated. The assumption is then made that a particle would be removed from the radiation belt if, in its normal motion, it would happen to impact a satellite. The mean absorption time before impact is calculated for particles located at the radial distance of each of the satellites. This average lifetime is found to be of the order of a few days. A characteristic diffusion time near each satellite was calculated, assuming violation of the third invariant due to magnetic fluctuations associated with fluctuations in the solar wind. This diffusion time is found to be long as compared with the absorption lifetimes at Europa (L=9.5), Io (L=6.0), and Amalthea (L=2.5). If magnetic fluctuations are the dominant diffusing force, these three satellites would act as a barrier to the inward diffusion of solar wind particles, and fluxes of trapped protons would be sharply reduced just inside the orbit of Europa; very few could diffuse past Io or Amalthea. The existence of energetic trapped electrons near L=2, however, indicates either that (1) perturbations in the electric or magnetic field near a satellite enable electrons to slip past without impacting the satellite, (2) diffusion of electrons in the region $2.5 < L < 9.5$ proceeds much more rapidly than calculations based on magnetic fluctuations have indicated, or (3) additional unknown acceleration processes give rise to energetic electrons in Jupter's inner magnetosphere. Even though electrons may diffuse easily in to L=2, however, it is quite possible for significant absorption of protons to occur. If absorption does occur near a satellite, the pitch angle distribution just inside the orbit would be expected to be sharply peaked near 90°, due to the 10° tilt of the magnetic dipole with respect to the rotational axis, which permits particles with equatorial pitch angles greater than 69° to diffuse past the satellite more easily without being absorbed. This may explain the highly peaked pitch angle distribution of trapped electrons observed just inside the orbit of Amalthea. (auth)

5954 THE O I 1304- AND 1356-A EMISSIONS FROM THE ATMOSPHERE OF VENUS. Strickland, D.J. (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 16, 2827-2836 (1 June 1973).

Theoretical O I 1304- and 1356-A intensities for Venus are presented, based on values of the excitation parameters consistent with estimates derived by Strickland et al. (1972) for Mars. Appropriate intensities are compard with the rocket data for Venus obtained by Moos and Rottman (1971) and are found to disagree seriously. Additional sources of photons at 1304 A and 1356 A are sought, but none are established as important. Alternatively, the values of the excitation parameters relative to the calibration may be in error. For a factor of 4 error, or less, the results indicate that more atomic oxygen is present in the thermosphere of Venus than Mars. This is not consistent with the interpretation of the Venera 4 1304-A data by Kurt et al. (1968). From the present analysis it is found that no useful upper limit to the atomic oxygen concentration can be estimated from the Venera data. (auth)

5955 OBSERVATIONAL CONSTRAINT ON THE STRUCTURE OF HYDROGEN PLANETS. Hubbard, W. B. (Univ. of Arizona, Tucson). Astrophys. J.; 182: No. 1, L35-L38(15 May 1973).

A measurement of temperature, pressure, and chemical composition of the convective portion of the atmosphere of a hydrogen–helium planet can be coupled to a theoretical many-body calculation in the metallic interior to derive a constraint on the internal temperature distribution. (auth)

5956 CONVECTION AND GRAVITATIONAL LAYERING IN JUPITER AND IN STARS OF LOW MASS. Salpeter, E. E. (Cornell Univ., Ithaca, NY). Astrophys. J.; 181: No. 2, L83-L86 (15 Apr 1973).

Neutral helium is probably insoluble in metallic hydrogen below some critical temperature. When Jupiter has cooled sufficiently, helium droplets can form, grow, and fall under gravity, leading to chemical separation and gravitational layering in spite of rapid convection. Applications to cool stars are discussed. (auth)

5957 RADIATION BELTS OF JUPITER. Stansberry, K. G. (Aerospace Corp., El Segundo, CA); White, R. S. Science; 182: No. 4116, 1020-1021(7 Dec 1973).

Predictions of Jupiter's electron and proton radiation belts are based mainly on decimeter observations of 1966 and 1968. Extensive calculations modeling radial diffusion of particles inward from the solar wind and electron synchrotron radiation are used to relate the predictions and observations. (auth)

5958 JUPITER'S RADIATION BELTS: CAN PIONEER 10 SURVIVE? Hess, W. N. (National Oceanic and Atmospheric Administration, Boulder, CO); Birmingham, T. J.; Mead, G. D. Science; 182: No. 4116, 1021-1022(7 Dec 1973).

Model calculations of Jupiter's electron and proton radiation belts indicate that the Galilean satellites can reduce particle fluxes in certain regions of the inner magnetosphere by as much as six orders of magnitude. Average fluxes should be reduced by a factor of 100 or more along the Pioneer 10 trajectory through the heart of Jupiter's radiation belts in early December. This may be enough to prevent serious radiation damage to the spacecraft. (auth)

5959 PHYSICS OF PLANETARY IONOSPHERES. Bauer, S. J. Physics and Chemistry in Space, Volume 6. New York; Springer-Verlag New York Inc. (1973). 237p. * $32.00.

This monograph concentrates on the fundamental physical and chemical processes in an idealized planetary ionosphere as a general abstraction, with actual planetary ionospheres representing special cases. Topics treated include neutral atmospheres, sources of ionization, thermal structure, chemical processes, plasma transport processes, models of planetary ionospheres, ionosphere as a plasma, experimental techniques, and observed properties of planetary ionospheres. (WDM)

5960 DYNAMICALLY PLAUSIBLE HYPOTHESES OF LUNAR ORIGIN. Kaula, W. M.; Harris, A. W. (Univ. of California, Los Angeles). Nature (London); 245: No. 5425, 367-369(19 Oct 1973).

It is stated that the finding that at least half the primordial Moon is enriched in refractory Al and Ca silicates, as well as the outer half being depleted in volatiles and the entire Moon being depleted in iron, has led to a renewed emphasis on the capture hypothesis of lunar origin. This emphasis springs partly from the need to have a high temperature, or low pressure, environment in which condensation, and hence presumably accretion, of substance less volatile than Fe predominates. The reasoning is that the Moon was made in a different place than now. The influence of tidal friction is discussed, in relation to energy sinks; and it is emphasized that tidal friction is an implausibly weak energy sink. Collision with matter already in orbit around the Earth is also discussed as a contributory energy sink, and it is calculated that the Moon needs to collide with only 2×10^{-5} of its own mass for collision to be a more efficient energy dissipator than tidal friction. A mechanism is needed for the Earth to acquire sufficient Moon mass in order to catch the whole Moon. It is concluded that collision with preexisting satellite matter is the most effective means of capturing the Moon. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 5959.

5961 (BNWL-SA-4788) STABLE AURORAL RED ARCS. Hoch, R. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Contract AT(45-1)-1830. 32p. (CONF-730962-1). Dep. NTIS $3.75.

Sar-arcs are diffuse, persistent, practically monochromatic (λλ6300 to 64A) auroral forms peculiar to mid-latitude regions of Earth. Measurements of such parameters as spectral composition, geomagnetic location, range of intensity, and frequency of occurrence lead to the conclusion that the phenomenon is due to the excitation of atomic oxygen by hot electrons in the plasmapause region. However, on the basis of the the data available, it is not clear whether fresh electrons are precipitating into the region of the arc or whether ambient electrons are being heated in place. There is strong evidence that the source of energy in either case is the ring current. Suggested mechanisms by which energy is transferred from the ring current to the electrons in the SAR-arc region are: 1) heat flow, that is, transfer of kinetic energy to the SAR-arc region by Coulomb collisions, 2) transfer of ring current proton kinetic energy to hydromagnetic waves which are in turn damped by the electrons in the SAR-arc region, 3) direct influx of energetic electrons into the SAR-arc region. Which of these mechanisms predominates is still not resolved at this time. There are other open questions as well including ones dealing with the motion of the arcs and the spectral composition. (auth)

5962 (LAFE-166) ATMOSPHERIC X-RAY MEASUREMENTS IN THE SOUTHERN HEMISPHERE USING STRATOSPHERIC BALLOONS. Martin, I. M.; de Almeida, W. A.; Cezac, Y.; Senador, R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Aug 1971. 42p. (In Portuguese). INIS.

X-ray (30 to 300 keV) flux measurements using a 2.54cm X 2.54cm NaI(Tl) detector are presented. A stratospheric balloon going up to an altitude of 38.6km was used. The launching took place in São Paulo, Brazil. An analysis of count rate vs. altitude was made during the flight. (auth)

5963 THERMOSPHERIC DENSITY VARIATIONS ASSOCIATED WITH AURORAL ELECTROJET ACTIVITY. Forbes, J.M.; Marcos, F.A. (Aeronomy Laboratory, Air Force Cambridge Research Laboratories, Bedford, Massachusetts, 01730). J. Geophys. Res. 78: No. 19, 3841-3847 (1 July 1973).

Thermospheric density variations observed during the time period of August 6–8, 1968, are studied in relation to auroral electrojet activity. In situ density measurements were obtained by the accelerometer experiment on the Air Force low-altitude density research satellite OV1-15. Density profiles were obtained in the altitude region 155–250 km and between 30° and 90°N geographic latitude. Densities at 134 km obtained from the orbital decay of satellite 1968-64A are compared with the accelerometer measurements. Enhanced density variations at high latitudes are observed and are found to be associated with auroral electrojet activity. The latitude of maximum density enhancement points to the existence of an auroral heat source. Furthermore, the appearance of a wavelike structure on several density profiles is apparently connected with intensifications of the electrojet current. (auth)

5964 METEOR TRAILS AND ATMOSPHERIC TURBULENCE. Zimmerman, S.P. (Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Massachusetts, 01730). J. Geophys. Res. 78: No. 19, 3927-3934 (1 July 1973).

The application of turbulence theory to atmospheric structure revealed by radio meteor trails clearly demonstrates that Batchelor's and Obhukoff's structure function for istropic turbulence explains some of the observed relations. From these measurements, parameters such as ϵ (the rate of viscous dissipation), $<u_{k'}{}^2>$ (the eddy intensity of the scales up to k' within the equilibrium range), Re_k (the local eddy Reynolds numbr describing the turbulence up to a scale k^{-1}), and ν_k and ν_b (turbulent viscosity coefficient to scale k^{-1} and the vertical turbulent viscosity up to the buoyancy limited scale l_b, respectively) are determined. Also, estimates of the rate at which turbulence extracts wind energy from the vertically propagating diurnal tide are given. The results of the parametric study suggest very strongly that the vertical turbulent spectrum, in the upper atmosphere, contains little or no energy extending into the inertial subrange but lies for the most part near the viscous end (high wave number) of the universal equilibrium subrange, owing to the energy transfer to buoyancy, which limits its low wave number value. (auth)

5965 ARBITRARY PROPAGATION OF HM WAVES ALONG THE F REGION. Galejs, J. (Naval Research Laboratory, Washington, D.C. 20390). J. Geophys. Res. 78: No. 19, 3894-3902 (1 July 1973).

Longitudinal and transverse propagation along an idealized three-region waveguide is examined prior to setting up a more general numerical solution that may account for arbitrary ionosphere parameters. For a nighttime ionosphere model, propagation in the east-to-west direction exhibits higher attenuation rates α than the propagation in the west-to-east direction, but α remains below 7 db/1000 km for dip angles $I > 75°$ and $I < 50°$. The phase velocity may exceed 2000 km/sec for the smaller values of I. For propagation between the east-to-west and north-to-south directions, modes of low attenuation rates are possible for large and small values of I, and again small values of I are associated with large phase velocities; however, there is also the possibility of highly attenuated modes for small dip angles I. (auth)

5966 MEASUREMENTS OF IONOSPHERIC REFLECTIVITY FROM 6 TO 35 kHz. Lewis, E.A.; Rasmussen, J.E.; Kossey, P.A. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts, 01730). J. Geophys. Res. 78: No. 19, 3903-3912 (1 July 1973).

Very low frequency pulses, less than 140 μsec in duration, were transmitted from a 1.5-km balloon-supported antenna wire. At receiving sites about 170 km away the direct and ionospherically reflected waves arrived completely separated in time and were analyzed individually. Amplitudes of the plane wave reflection coefficients, $_{s}R_{s}$ and $_{s}R_{i}$ are given for 7 of the 60 or more equivalent mirror heights of reflection. Diurnal, seasonal, and geomagnetic azimuth effects are described. (auth)

5967 ANALYSIS AND INTERPRETATION OF ASPECT-DEPENDENT IONOSPHERIC RADAR SCATTER. Minkoff, J. (Riverside Research Institute, New York, New York, 10023). J. Geophys. Res. 78: No. 19, 3865-3880 (1 July 1973).

Aspect-dependent radar scattering from ionospheric phenomena such as the aurora is known to be dependent on the three-dimensional wave-number spectrum of the random electron-density fluctuations as well as the mean-square deviation of the fluctuations. In characterizing the wavenumber spectrum, it is convenient to speak of the longitudinal and transverse scale sizes or coherence lengths, L and T, which describe, respectively, the average distances parallel and perpendicular to the geomagnetic field over which collective scattering effects take place. An analysis of the scattering process is presented in which the relationships between these ionospheric quantities and those quantities which are actually observed in an experimental situation are determined. With the use of these relationships, it is shown that the values of the experimental parameters impose fundamental limitations on the extent to which the quantities of interest can actually be measured in any given experimental situation. In particular, it is shown that the vertical antenna aperture D sets the limit on the largest value of L that can actually be determined. If $D/L \leq 1$, it is shown that the apparent measured value of L will always be very close to D, regardless of the true value of L; some experimental results are considered in the light of this effect. It is shown that an analogous situation can occur if the transmitted pulse width is too long, but, in practice, this limitation is not as restrictive. The correct normalization of measured values of received signal strengths necessary to determine the scattered power per unit volume is also complicated by the aspect sensitivity of the scattering. It is shown that this problem can be considerably alleviated with the proper choice of experimental parameters. From these considerations, an ideal antenna configuration for making such measurements is suggested. An extension of the analysis to bistatic scattering is also considered. The measurement of the variance of the electron-density fluctuations is discussed. (auth)

5968 SATELLITE OBSERVATIONS OF STRONG BALMER ALPHA ATMOSPHERIC EMISSIONS AROUND THE MAGNETIC EQUATOR. Levasseur, A.C.; Blamont, J.E. (Service d'Aéronomie du CNRS, Verrières le Buisson, France). J. Geophys. Res. 78: No. 19, 3881-3893 (1 July 1973).

Balmer α emissions of intensity larger than three times the nominal value have been recorded during five different nights at geomagnetic latitudes inferior to ±22°. They are correlated with sudden impulses in magnetograms. (auth)

5969 ION CYCLOTRON WAVES OBSERVED IN THE POLAR CUSP. Fredricks, R.W. (Space Sciences Department, TRW Systems Group, Redondo Beach, California, 90278); Russell, C.T. J. Geophys. Res. 78: No. 16, 2917-2925 (1 June 1973).

During the penetration by Ogo 5 of the low-latitude disturbed polar cusp region on November 1, 1968, while a major magnetic storm was in progress, a variety of plasma wave activity was observed. The present paper describes observations of waves with amplitudes <2% of the background magnetic field intensity and having frequencies between approximately 0.67 and 0.87 times the local proton gyrofrequency. The polarization of these waves indicates they are propagating at an

appreciable angle to the local geomagnetic field line direction. The source of these waves has not been determined, but currents and gradient drifts are suggested as possible agents. (auth)

5970 F-LAYER AND 6300-A MEASUREMENTS IN THE DAY SECTOR OF THE AURORAL OVAL. Whalen, J.A.; Pike, C.P. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts, 01730). J. Geophys. Res. 78: No. 19, 3848-3856 (1 July 1973).

A circum-oval flight by the AFCRL flying ionospheric laboratory over the Arctic Ocean from Keflavik, Iceland, to Fairbanks, Alaska, passed completely around the auroral oval under conditions of darkness. Airborne all-sky cameras, a photometer, and a vertical incidence ionospheric sounder permitted the tracing out of the latitudinal and longitudinal (local time) extent of discrete auroral forms, auroral emissions, and ionospheric features. In the geomagnetic day sector, between 0820 and 1730 corrected geomagnetic (CG) local times, a continuous band of enhanced 6300-A emission ('red band') was found to be coincident with an F-layer irregularity zone (FLIZ). The red band was 2° to 5° wide and occurred between 75.0° and 80.0° corrected geomagnetic latitude. Although discrete auroras were absent at times, when they occurred, they lay within the red band. Past observations had indicated a close correspondence at noon between the red band and discrete auroral, but on this day no discrete aurora was observed in the noon sector. The red band and the FLIZ may have extended from the day sector into the night sector, but, unfortunately, the aircraft was not favorably located to determine the continuity. In the geomagnetic day sector the red band and the FLIZ are most probably produced by low-energy electrons that have precipitated through the polar cusp. Therefore, by tracing out the latitudinal and longitudinal (local time) extent of the red band and the FLIZ, we have mapped, over the extent of our observations, the zone of the ionospheric response to these low-energy electrons. This zone coincided with the dayside auroral oval. (auth)

5971 FIRST RESULTS FROM THE NORTH POLAR AURORAL RADAR. Bates, H.F.; Akasofu, S.; Kimball, D.S. (Geophysical Institute, University of Alaska, Fairbanks, Alaska, 99701); Hodges, J.C. J. Geophys. Res. 78: No. 19, 3857-3864 (1 July 1973).

This paper reports a preliminary result from the operation of the polar auroral radar (a HF sweep frequency sounder with an antenna having a rotation period of 6 min) located at Resolute Bay, North West Territories, Canada. With the aid of all-sky photographs and statistical auroral data it is shown that such a radar can locate the instantaneous position of the auroral oval. (auth)

5972 COSMIC RAY TOTAL IONIZATION, 1970-1972. Anderson, H.R. (Department of Space Sciences, Rice University, Houston, Texas, 77001). J. Geophys. Res. 78: No. 19, 3958-3960 (1 July 1973).

Yearly measurements of total cosmic ray ionization rate as a function of atmospheric depth have been continued in 1970-1972 at Fort Churchill. Although solar minimum is not expected until 1975-1976, the ionization role in July 1972 was approximately the same as in 1965, the last solar minimum. (auth)

5973 UNUSUAL LF RADIO ABSORPTION EVENTS DURING A MAJOR METEOR SHOWER. Sen, A.K.; Saha, B. (Centre of Advanced Study in Radio Physics and Electronics, University of Calcutta, Calcutta, India). J. Geophys Res. 78: No. 19, 3998-4000 (1 July 1973).

During the period of the major meteor shower, Perseids, certain peculiar long-duration LF radio absorption events were observed at Calcutta that were indicative of the formation of significant meteor ionization below the E region reflection level involved. Some of the interesting results obtained from an analysis of the records of 1972 are presented. (WDM)

5974 NOTE ON THE SEMIANNUAL EFFECT IN THE THERMOSPHERE. Volland, H. (Astronomical Institutes, University of Bonn, Bonn, Germany); Mayr, H.G. J. Geophys. Res. 78: No. 19, 3991-3994 (1 July 1973).

An attempt is made to show that a number of apparent conflicts in the description and interpretation of the semiannual effect can be resolved by considering some of the dynamic properties of the thermosphere. (WDM)

5975 TYPE III SPECTRA OF THE RADAR AURORA. D'Angelo, N. (Danish Space Research Institute, Lyngby, Denmark). J. Geophys. Res. 78: No. 19, 3987-3990 (1 July 1973).

The type III spectra of the radar aurora, reported by Balsley and Ecklund (1972), are interpreted in terms of electrostatic ion cyclotron waves excited by current flow along the geomagnetic field lines. (auth)

5976 OCCURRENCE OF IPDP EVENTS ACCOMPANIED BY COSMIC NOISE ABSORPTION IN THE COURSE OF PROTON AURORA SUBSTORMS. Fukunishi, H. (Geophysical Institute, University of Tokyo, Tokyo, Japan). J. Geophys. Res. 78: No. 19, 3981-3986 (1 July 1973).

An attempt is made to confirm the ion cyclotron resonance mechanism for the IPDP event by investigating the relation among IPDP event, proton aurora, and cosmic noise absorption during a magnetospheric substorm. (WDM)

5977 AN EXAMPLE OF ANTICORRELATION OF AURORAL PARTICLES AND ELECTRIC FIELDS. Maynard, N.C. (Goddard Space Flight Center, Greenbelt, Maryland, 20771); Bahnsen, A.; Christophersen, P.; Egeland, A.; Lundin, R. J. Geophys. Res. 78: No. 19, 3976-3980 (1 July 1973).

The question of whether correlation or anticorrelation should occur is considered. Data from a case on Nov. 13, 1970 is presented in which an anticorrelation between auroral particles and electric fields is especially striking. (WDM)

5978 DISTORTIONS OF THE NIGHTSIDE IONOSPHERE DURING MAGNETOSPHERIC SUBSTORMS. Park, C.G. (Radioscience Laboratory, Stanford University, Stanford, California, 94305); Meng, C.I. J. Geophys. Res. 78: No. 19, 3828-3840 (1 July 1973).

Ionosonde records from widely spaced ground stations show that during magnetospheric substorms the F layer is pushed upward in the premidnight local time sector and downward in the postmidnight sector. The area affected probably depends on the substorm intensity, but it may be as large as ≈20°-60° in geomagnetic latitude and ≈9 hours in local time. These distortions are believed to be caused by eastward electric fields do not in the evening side and westward fields in the morning side. The inferred ionospheric electric fields do not show close correlation with magnetic perturbations at middle latitudes, thus suggesting that the latter are caused primarily by magnetospheric currents. The F-layer concentrations change as a result of vertical motions of the layer and influx of thermal plasma from the plasmasphere. In one of the cases reported, a thick nocturnal E layer with $F_0E \approx 2.5$ MHz was observed near 60° geomagnetic latitude. This effect is attributed to substorm-induced precipitation of energetic particles. (auth)

5979 ADDITIONAL RESULTS FROM AN OGO 6 EXPERIMENT CONCERNING IONOSPHERIC ELECTRIC AND ELECTROMAGNETIC FIELDS IN THE RANGE 20 Hz TO 540 kHz. Laaspere, T.; Johnson, W.C. (Radiophysics Laboratory, Dartmouth College, Hanover, New Hampshire, 03755). J. Geophys. Res. 78: No. 16, 2926-2944 (1 June 1973).

Ogo 6 was launched on June 5, 1969, into a polar orbit with a perigee of 400 km and an apogee of about 1100 km; normal Ogo 6 operations were terminated on June 28, 1971. Our experiment on the spacecraft yielded real time analog data in four 15-kHz bands (20 Hz to 15 kHz, 15-30 kHz, 92.5-107.5 kHz, and 280-295 kHz), and tape-recorded digital data in two 200-Hz bands (200 kHz and 540 kHz), and from a broad band intensity detector. The experiment sensor consisted of an electric dipole with a tip-to-tip length of about 24 meters. This paper summarizes those findings from the experiment that have not been published previously. These include the following: (1) an observation of emissions triggered by proton whistlers, (2) numerous clear examples of whistler-associated lower hybrid resonance (LHR) noise, (3) new results on the auroral hiss zone and on its relation to the high-altitude polar cusp, and (4) new results on emissions triggered by VLF stations, which point to a similarity netween whistler precursors and triggered emissions, suggesting a similarity in the generation mechanisms. (auth)

5980 INCOHERENT SCATTER OBSERVATIONS OF THE IONOSPHERE OVER CHATANIKA, ALASKA. Watt, T.M. (Stanford Research Institute, Menlo Park, California, 94025). J. Geophys. Res. 78: No. 16, 2992-3006 (1 June 1973).

The behavior of the ionosphere over Chatanika, Alaska, has been observed through seven 24-hour incoherent scatter measurements made during July, August, and September 1971 and February 1972. The observed behavior is very complex as a result of the competing influence of solar extreme ultraviolet (EUV) flux and energetic particle precipitation. It has been possible, however, to separate the observational data into three categories: solar EUV, auroral oval, and magnetically disturbed periods. Within the category solar EUV the observed behavior relates quite well to the indices' solar zenith angle and 10.7-cm solar flux. Within the category auroral oval the observed behavior is consistent with the local magnetic K index and statistical results of other workers. Both qualitative and quantitative relations between the various parameters are discussed. (auth)

5981 AURORAL OVAL. Feldstein, Y.I. (IZMIRAN, Academy of Sciences, Moscow, USSR). J. Geophys. Res. 78: No. 7, 1210-1213 (1 Mar 1973).

It is proposed that the auroral oval consists of two parts, the dayside half and the nightside half, although together they form the single oval band. On the basis of recent literature, this view is held to be better than the concept of two circular zones put forward by Mishin et al. (1970 a,b). (WDM)

5982 ON THE VERTICAL MOVEMENT OF SPORADIC E. Pradhan, S.M.; Srivastava, S.K.; Singh, B.; Tantry, B.A.P. (Electronics and Radiophysics Laboratory, Department of Physics, Banaras Hindu University, Varanasi, India). J. Geophys. Res. 78: No. 7, 1232-1234 (1 Mar 1973).

It is seen from observations of Bedinger and Smith (1967) and Smith (1970) that in a particular height range the downward velocity of the upper E_s layer decreases as the layer descends. This phenomenon may be attributed to the effect of viscosity on the phase velocity of the gravity waves and is the topic of primary importance discussed in this letter. (WDM)

5983 SOME CHARACTERISTICS OF THE IONOSPHERIC IRREGULARITIES ASSOCIATED WITH E_{sq} LAYERS. Chandra, H.; Rastogi, R.G. (Physical Research Laboratory, Ahmedabad, India). J. Geophys. Res. 78: No. 16, 3007-3012 (1 June 1973).

Spaced fading records at Thumba for times when E_{sq} disappears following large changes in the geomagnetic H component are studied. The results for the periods when E_{sq} is present are known to show fast fading, westward drift, and highly elongated ground diffraction patterns with a small semiminor axis. During periods when there is no E_{sq} the fadings are found to be very slow, the drift direction is reversed to the east, and the ground diffraction pattern becomes almost isotropic with a large semiminor axis, whose alignment is a few degrees off the magnetic N–S direction. The characteristics of the fading and those of the ground diffraction pattern when E_{sq} disappears are similar to the characteristics usually obtained at latitudes well away from the equator. The E_{sq} is thus suggested to be a superposition of additional irregularities over the normal E region irregularities (similar to those in the E region at nonequatorial latitudes). Close dependence of the direction of the electric field with the occurrence of E_{sq} favors the conclusion that E_{sq} is due to the crossfield instability created by the action of the H field with the Hall polarization field and the plasma density gradient. (auth)

5984 CAN THE IONOSPHERE REGULATE MAGNETOSPHERIC CONVECTION? Coroniti, F.V.; Kennel, C.F. (Plasma Physics Group, Department of Physics, University of California, Los Angeles, California, 90024). J. Geophys. Res. 78: No. 16, 2837-2851 (1 June 1973).

Following a southward shift of the interplanetary magnetic field, which implies enhanced reconnection at the nose of the magnetosphere, the magnetopause shrinks from its Chapman-Ferraro equilibrium position. If the convective return of magnetic flux to the magnetopause equaled the reconnection rate, the magnetopause would not shrink. Consequently, there is a delay in the development of magnetospheric convection following the onset of reconnection, which we ascribe to line tying by the polar cusp ionosphere. A simple model relates the dayside magnetopause displacement to the currents feeding the polar cap ionosphere, from which the ionospheric electric field, and consequently the flux return rate, may be estimated as a function of magnetopause displacement. Flux conservation arguments then permit an estimate of the time scale on which convection increases, which is not inconsistent with that of the substorm growth phase. (auth)

5985 ION HEATING IN THERMAL PLASMA FLOWS. Banks, P.M. (Radioscience Laboratory, Stanford University, Stanford, California, 94305). J. Geophys. Res. 78: No. 16, 3186-3188 (1 June 1973).

During the past five years there has been increasing appreciation of the importance of thermal plasma exchange between the ionosphere and various regions of the magnetosphere. The general effects of these exchanges on the thermal structure of the upper ionosphere and inner magnetosphere are discussed. (WDM)

5986 OBSERVATIONS OF THE AURORAL OVAL AND A WESTWARD TRAVELING SURGE FROM THE ISIS 2 SATELLITE AND THE ALASKAN MERIDIAN ALL-SKY CAMERAS. Anger, C.D.; Lui, A.T.Y. (Department of Physics, University of Calgary, Calgary, Alberta, Canada); Akasofu, S. J. Geophys. Res. 78: No. 16, 3020-3026 (1 June 1973).

This note reports observations of the auroral oval and a westward traveling surge as observed form the Isis 2 auroral scanning photometer and from the Alaskan meridian chain of all-sky camera stations on December 14, 1971. (auth)

5987 RED AURORAS IN THE MORNING SECTOR. Akasofu, S.-I.;Yasuhara, F. (Geophysical Institute, University of Alaska, Fairbanks, Alaska, 99701). J. Geophys. Res. 78: No. 16, 3027-3032 (1 June 1973).

The distribution, orientations, and substorm behaviors of red auroras in the morning sector, which were observed during the NASA airborne auroral observations in December 1969, are reported. Combining earlier and present observations, we confirm that red arcs are present in the polar cap along the entire section of the midday part of the oval and along the poleward edge of the oval in the dark sector. It is suggested that red arcs along the poleward boundary of the oval are caused by precipitation of a few hundred electron volt electrons that are present in the upper (northern) and lower (southern) boundary layers of the plasma sheet. (auth)

5988 RELATIONSHIP OF SOUTHWARD-DRIFTING AURORAL ARCS TO THE MAGNETOSPHERIC ELECTRIC FIELD AND SUBSTORM ACTIVITY. Subbarao, S.; Rostoker, G. (Institute of Earth and Planetary Physics, University of Alberta, Edmonton, Alberta, Canada). J. Geophys. Res. 78: No. 7, 1100-1106 (1 Mar 1973).

The magnitude of the westward-directed auroral zone electric field is inferred from the measurement of the southward drift of moderately bright auroral arcs. In a sample of 43 events recorded over a period of 15 months at Fort Smith (68.1°N corrected geomagnetic) it was found that southward-drifting arcs were predominantly associated with the decay phase of polar magnetic substorms, and no evidence was found for the association of southward-drifting arcs with the so-called growth phase of substorms. It is suggested that the southward-drifting arcs are generated through the precipitation and energetic plasma affected by the limit on stably trapped particle fluxes proposed by Kennel and Petschek (1966). (auth)

5989 LARGE N_i GRADIENTS BELOW THE EQUATORIAL F PEAK. Hanson, W.B.; Sanatani, S. (The University of Texas at Dallas, Dallas, Texas, 75230). J. Geophys. Res. 78: No. 7, 1167-1173 (1 Mar 1973).

Very large vertical and longitudinal gradients in the ion concentrations are observed below the F peak near the magnetic equator with the retarding potential analyzer on Ogo 6. Ion concentration 'bite outs' of up to a factor of 10^3 are observed above 400 km. They appear to be associated with the bottomside of the nighttime F layer. The ion composition in the minimums may contain large fractions of ions heavier than O^+ (e.g., NO^+ and Fe^+). It is suggested that convective electric fields associated with spread F steepen the bottomside of the F layer and also introduce longitudinal irregularities in the vertical N_i profiles. (auth)

5990 SIMULTANEOUS OCCURRENCES OF HYDROGEN ARCS AND MID-LATITUDE STABLE AURORAL RED ARCS. Kleckner, E.W.; Hoch, R.J. (Battelle–Northwest Laboratories, Richland, Washington, 99352). J. Geophys. Res. 78: No. 7, 1187-1193 (1 Mar 1973).

Observational evidence of the simultaneous occurrences of hydrogen (H arcs) and mid-latitude stable auroral red arcs (SAR arcs) is presented for seven occasions during the period September 1967 to May 1971. The H arc occurred on the average about 1.6 units of L value poleward of the SAR arc, the maximum separation being 2.0 units and the minimum 0.8 units. Comparison with magnetospheric data is made for one particular storm (March 23–24, 1969). These data, as well as the comparison of H arc fluctuations with Dst variations, the estimates of overall energy, and other arguments, are all consistent with the hypothesis that the relatively low latitude H arcs observed are associated with the ring current peak, whereas the SAR arcs are associated with the interface region where the ring current intersects the plasmasphere. (auth)

5991 SENSITIVITY STUDY OF THE PARTIAL REFLECTION EXPERIMENT. Newman, D.B. Jr.; Ferraro, A.J. (Ionosphere Research Laboratory, Pennsylvania State University, University Park, Pennsylvania, 16802). J. Geophys. Res. 78: No. 4, 774-777 (1 Feb 1973).

The wave interaction facility is presently being modified for the partial reflection experiment. This will give the capabilities at 500 kW peak transmitter power at 4.5 MHz with transmission and reception on an antenna with 13.4-db gain. The results of a study on equipment sensitivity requirements are given. (WDM)

5992 DEFORMATION AND STRIATION OF PLASMA CLOUDS IN THE IONOSPHERE, 1. Perkins, F.W.; Zabusky, N.J.; Doles III, J.H. (Bell Telephone Laboratories, Incorporated, Whippany, New Jersey, 07981). J. Geophys. Res. 78: No. 4, 697-709 (1 Feb 1973).

We derive the equations that govern the nonlinear motion of plasma clouds in the ionosphere, including the effects of finite temperature and resistivity along the magnetic field lines. The principal application is to large barium clouds, which contain enough plasma to dominate the integrated Pedersen conductivity on lines of force that pass through the cloud and are sufficiently high so that $\Omega_i/\nu_{in} \gg 1$. Approximate solutions to the nonlinear equations in simplified geometries show that the plasma clouds deform in a manner that qualitatively agrees with observations. Numerical solutions are presented in a companion paper. Finite resistivity along the magnetic field has two effects. First, it governs the short-wavelength limit for striations. Second, for small plasma clouds (those whose contribution to the height-integrated conductivity is small), finite resistivity requires that a substantial electric field be present ($\sim 10^2$ mv/m) in order that the growth rate for striations circumvent a reduction by the short-circuiting effect. (auth)

5993 DEFORMATION AND STRIATION OF PLASMA CLOUDS IN THE IONOSPHERE 2. NUMERICAL SIMULATION OF A NONLINEAR TWO-DIMENSIONAL MODEL. Zabusky, N.J.; Doles III, J.H.; Perkins, F.W. (Bell Telephone Laboratories,

Incorporated, Whippany, New Jersey, 07981). J. Geophys. Res. 78: No. 4, 711-724 (1 Feb 1973).

We present and solve numerically a coupled pair of nonlinear partial differential equations that describe the self-consistent evolution transverse to the magnetic field of plasma clouds artificially formed in the ionosphere. This model assumes that the height-integrated Pedersen conductivity of the cloud dominates the ionospheric contribution and that the cloud is sufficiently high so that $\kappa_i = \Omega_i/\nu_{in} \gg 1$. Several initial states are examined, and many features of field observations of recent barium releases are obtained: early time elongations on the E×B direction (due to convection and not diffusion), backside steepening, slower frontside motion, and striations or development of fingerlike sheets of plasma structure on the backside with a long-time tendency to fission into rods. The onset time for striations is a complicated function of the shape of the cloud, the intensity, the structure, and the location of the initial perturbation and the underlying dissipation. (auth)

5994 METALLIC IONS IN THE EQUATORIAL IONOSPHERE Aikin, A.C.; Goldberg, R.A. (Laboratory for Planetary Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 4, 734-745 (1 Feb 1973).

Four positive ion composition measurements of the equatorial E region at Thumba, India, are presented. During the day, the major ions between 90 and 125 km are NO^+ and O_2^+. The relative concentrations are similar to those observed at midlatitudes but exhibit unusual structural behavior with altitude. A metallic ion layer centered at 92 km is found to contain Mg^+, Fe^+, Ca^+, K^+, Al^+, Na^+, and possibly Si^+ ions. The layer is explained in terms of a similarly shaped altitude distribution of neutral atoms that are photoionized and charge exchanged with NO^+ and O_2^+. Three-body reactions form molecular metallic ions that are rapidly lost by dissociative ion-electron recombination. Unfortunately reactions that create molecular ions from Na^+ and K^+ using CO_2 as a third body to form cluster ions are too slow to account for the observed alkali metal ion distribution. Nighttime observations show downward drifting of the metallic ion layer caused by equatorial dynamo effects. The increased ion-electron recombination, induced by the downward drifting electrons, produces an observed depletion of NO^+ and O_2^+ within the metallic ion region. The inclusion of drift effects is found to be necessary in producing a proper description of metal ion behavior at the magnetic equator. Similar considerations are probably appropriate at other latitudes. (auth)

5995 RELATIONS BETWEEN IONOSPHERIC ELECTRIC FIELDS AND ENERGETIC TRAPPED AND PRECIPITATING ELECTRONS. Mozer, F.S. (Physics Department and Space Sciences Laboratory, University of California, Berkeley, 94720); Bogott, F.H.; Tsurutani, B. J. Geophys. Res. 78: No. 4, 630-639 (1 Feb 1973).

Balloon-borne electric field and X ray detectors have been flown from Fort Churchill and from near the foot of the magnetic field line on which the ATS 5 satellite is located in order to obtain satellite and balloon measurements of trapped and precipitating particles and to compare them with balloon measurements of the ionospheric electric field. The approximately 80 hours of coordinated data show that nighttime precipitation events (1) are preceded by enhancements of the westward component of ionospheric electric field about 70% of the time, (2) cause the westward electric field strength to decrease about 70% of the time, (3) are unrelated to variations of the southward component of the ionospheric electric field. The westward electric field enhancement before many precipitation events occurs when the trapped electron flux is at or near the stable trapping limit. Such precipitation events are therefore interpreted as resulting from enhanced pitch angle scattering by whistler mode waves as the trapped electron flux exceeds the stable trapping limit due to the inward convection associated with the enhanced westward field. This model explains the observed diurnal dependence of the phenomenon and the poor correlation between trapped and precipitated electron intensities reported in this paper. The decrease of the westward ionospheric electric field during many precipitation events is interpreted as due to ≈25-kev potential drops along magnetic field lines resulting from the increased currents flowing during precipitation. The geometry of the westward electrojet current flow is such that the westward ionospheric electric field should decrease and little or no variation should occur in the southward component during precipitation, in agreement with the experimental data. (auth)

5996 MEASUREMENT OF AURORAL BIRKELAND CURRENTS AND ENERGETIC PARTICLE FLUXES. Cloutier, P.A.; Sandel, B.R.; Anderson, H.R.; Pazich, P.M.; Spiger, R.J. (Department of Space Science, Rice University, Houston, Texas, 77001). J. Geophys. Res. 78: No. 4, 640-647 (1 Feb 1973).

A rocket-borne experiment containing a vector magnetometer and a set of charged-particle detectors was launched from Poker Flat, Alaska, at 2217 LT on February 13, 1971, over a single auroral arc. Particle data in the energy range 0.5-20 kev, obtained during part of the flight, show a peak incident flux of 4×10^7 el/cm^2 sec ster kev in the energy range 1-2 kev. The pitch angle distributions of these precipitating electrons were found to be fairly isotropic from 0° to 60° and to decrease from 60° to 90°. The results of the vector magnetometer indicate the existence of a system of Birkeland currents with magnitudes of 5×10^{-6} amp/m^2 in the vicinity of the auroral arc. Two different models that fit the data are discussed. In both of these models the current carried by precipitating electrons opposed the net downward current measured by the magnetometer in the same region, this region being located south of that containing the peak auroral luminosity. The net upward current measured by the magnetometer flowed somewhat north of the peak auroral luminosity. (auth)

5997 AURORA AND THE POLEWARD EDGE OF THE MAIN IONOSPHERIC TROUGH. Bates, H.F.; Belon, A.E.; Hunsucker, R.D. (Geophysical Institute, University of Alaska, College, Alaska, 99701). J. Geophys. Res. 78: No. 4, 648-658 (1 Feb 1973).

The Chatanika incoherent scatter radar was used on fifteen days during the winter of 1971-1972 to provide data on ionospheric parameters in a meridional cross section of the auroral zone. On three of these days the aurora was quiet and conditions were sufficiently stable that variations during the observations could be ignored. These three cases, supported by the other less well-defined cases, provide the following results: (1) during one quiet period, the main ionospheric trough extended from 69° down to at least 61° geomagnetic latitude; (2) the poleward edge of the trough was a steep horizontal electron density gradient (essentially a wall of ionization) that is approximately field aligned, and its position appears to be determined not by the concurrent position of the visual aurora but by the most equatorward position of the visual aurora during the preceding hours; and (3) the maximum F region electron density in the space between the trough and the visual aurora occurs 1 to 2 deg of latitude equatorward of the aurora. These results are interpreted in terms of a qualitative model that invokes the equatorward and upward transport of aurorally produced ionization by collisional coupling with an equatorward neutral wind caused by auroral heating. (auth)

5998 DIFFERENCES IN AURORAL INTENSITY AT CONJUGATE POINTS. Stenbaek-Nielsen, H.C.; Wescott, E.M.; Davis, T.N. (Geophysical Institute, University of Alaska, College, Alaska, 99701); Peterson, R.W. J. Geophys. Res. 78: No. 4, 659-671 (1 Feb 1973).

Conjugate auroral all-sky camera data obtained in 18 flights through the auroral zone near the College, Alaska, magnetic meridian show hemispherical differences in auroral frequency and intensity. Conjugate auroras on the equatorward boundary of the display (the equatorward arc system) are found to be consistently brighter in the northern hemisphere by a factor of approximately 1.3. At higher latitudes (in the poleward arc system) the auroras exhibit varying degrees of conjugacy, but the auroras in the north tend to occur more frequently and to be brighter. The hemispherical difference is attributed to the 8000-γ difference in magnetic field strength between the conjugate areas. Simplified theoretical calculations of the difference in precipitation at conjugate points from idealized cases of pitch angle diffusion and from a small hemispherical potential difference show that pitch angle diffusion may explain observations in the equatorward arc system but not in the poleward arc system. The evidence for hemispheric differences in auroral particle precipitation adds substantially to earlier indications of variation with longitude of auroral precipitation patterns. (auth)

5999 ISOTROPY OF AURORAL ELECTRONS. Comments on Pitch Angle Variation of Auroral Electrons Slowing Down in the Upper Atmosphere by F. A. Hanser and B. Sellers. Judge, R. (Univ. of California, La Jolla, San Diego). Planet. Space Sci.; 21: No. 11, 2043-2045(Nov 1973).

Recomputations of a previous calculation of auroral excitation have been made using different forms of geomagnetic dependence of electron trajectories. The results indicate that auroral profiles and luminosity ratios are insensitive to such forms, and that their variation depends to a greater degree on the isotropy of the particle flux. It is suggested that the inclusion of multiple scattering in a theoretical treatment of an isotropic beam would have similarly small effects. (auth)

6000 PITCH ANGLE VARIATION OF AURORAL ELECTRONS SLOWING DOWN IN THE UPPER ATMOSPHERE. Hanser, F. A.; Sellers, B. (Panametrics, Inc., Waltham, MA). Planet. Space Sci.; 21: No. 11, 2042-2043(Nov 1973).

In calculation of the pitch angle variation of auroral electrons the correct equation is $\sin^2\theta/B = C$, in contrast to $E \sin^2\theta/B = C$, which has been used in an earlier calculation. (auth)

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Refer also to abstracts 5869, 5978, and 5984.

6001 (KFKI-73-30) SPATIAL DISTRIBUTION OF CHARGED PARTICLES BENEATH THE RADIATION BELTS AS MEASURED ON BOARD OF THE SATELLITE "INTERCOSMOS-3". Bano, M.; Dubinsky, J.; Fischer, S. (Kozponti Fizikai Kutato Intezet,

Budapest (Hungary)). Jun 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.00.

Properties of charged particle fluxes observed under the radiation belts up to shells L=3 are described. In these regions, a storing process of dissipated electrons with energies $E_e > 40$keV is operating continuously and leads to a characteristic longitude dependence of the intensity of dissipated electrons. It is shown that, as the electrons are drifting round the Earth, the majority of them die out in the region of the Brazilian anomaly, where their trajectories merge into the atmosphere. Summarized and averaged data measured during the violent geomagnetic storm of Oct. 17, 1970 and immediately after it, during a time of moderate geomagnetic disturbance Oct. 19, 1970 are given. The intensity of dissipated electrons is observed to increase with increasing storm parameter, S. Intensities of penetrating particles (cosmic rays and their secondaries) are given as function of L. The values obtained are in good agreement with those measured during the solar activity cycle 19, in the years 1959–60. Attention is drawn to a significant increase of penetrating particle intensities in equatorial regions at longitudes 100 to 150°. (auth)

6002 THIRTEEN NEW H_2O SOURCES ASSOCIATED WITH OH EMISSION IN H II REGIONS. Johnston, K. J.; Sloanaker, R. M.; Bologna, J. M. (Naval Research Lab., Washington, DC). Astrophys. J.; 182: No. 1, 67–75(15 May 1973).

Thirteen new H_2O emission sources associated with OH emission sources in H II regions have been discovered. This increases the total number of such sources to 37. Taking the great variability of the intensities of H_2O sources into account, the statistics indicate that probably all type I OH emission sources are associated with H_2O sources although the H_2O emission has not been detectable in many cases. (auth)

6003 SOLAR WIND INTERACTION WITH THE EARTH'S MAGNETIC FIELD. 1. MAGNETOSHEATH. Formisano, V.; Moreno, G.; Palmiotto, F. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Ricerche Istituto di Fisica, Università di Roma, Rome, Italy); Hedgecock, P.C. J. Geophys. Res. 78: No. 19, 3714-3730 (1 July 1973).

Properties of plasma and magnetic field within the magnetosheath in the period December 1968 to December 1969 are presented as observed by the European satellite Heos 1. Three states of the magnetosheath plasma have been distinguished on the basis of different upstream conditions and are characterized by low magnetosonic Mach number ($M_1 < 3$) and low β, high values of M_1 and β and absence of upstream waves, and presence of upstream waves. The distribution function of proton velocities and the magnetic turbulence in the magnetosheath have been studied in connection with these three upstream situations. (auth)

6004 SOLAR WIND INTERACTION WITH THE EARTH'S MAGNETIC FIELD. 2. MAGNETOHYDRODYNAMIC BOW SHOCK. Formisano, V. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Richerche, Istituto di Fisica, Universitá di Roma, Rome, Italy); Hedgecock, P.C.; Moreno, G.; Palmiotto, F.; Chao, J.K. J. Geophys. Res. 78: No. 19, 3731-3744 (1 July 1973).

The earth's bow shock has been investigated as a magnetohydrodynamic discontinuity using the plasma and magnetic data supplied by the European satellite Heos 1. The jumps of the fluid parameters through the shock have been studied as a function of the Mach number and of the geometry of the shock surface. The solar wind specific heat ratio has been found to be $\gamma_1 = 1.75$ or 2.25 depending on the presence or absence of upstream waves. Computations of the shock velocity performed for 23 crossings gave an average speed of ∼85 km/sec. (auth)

6005 SOLAR WIND INTERACTION WITH THE EARTH'S MAGNETIC FIELD. 3. ON THE EARTH'S BOW SHOCK STRUCTURE. Formisano, V. (Laboratorio Plasma Spazio, Consiglio Nazionale delle Ricerche, Istituto di Fisica, Università di Roma, Rome, Italy). J. Geophys. Res. 78: No. 19, 3745-3760 (1 July 1973).

A classification of earth's bow shock structures on the basis of upstream M_A, β, $\Delta = \angle Bn$ (angle between shock normal and magnetic field direction) has been found. Typical properties for each case are studied. In particular, the downstream turbulence present in $|\vec{H}|$ has been positively correlated with upstream β. It is suggested that the shock precursor, as far as low-frequency waves are concerned, is always due to waves generated upstream and carried by the solar wind. The use of the shock velocity allows estimation of the shock thickness: if $M_A < 3$, the shock is a few ion gyrorsdii thick. (auth)

6006 DEPENDENCE OF THE POLAR CUSP ON THE NORTH–SOUTH COMPONENT OF THE INTERPLANETARY MAGNETIC FIELD. Kivelson, M.G.; Russell, C.T. (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024); Neugebauer, M.; Scarf, F.L.; Fredricks, R.W. J. Geophys. Res. 78: No. 19, 3761-3772 (1 July 1973).

Ogo 5 observations of the polar cusp on November 1, 1968, show that the north–south component of the interplanetary field exhibits control over both the location of and the physical processes occurring in the polar cusp. When the interplanetary field turned from north to south, the polar cusp moved equatorward. During intervals when the interplanetary field was southward, the electron temperature in the polar cusp was lower and the currents were stronger than when the interplanetary field was northward. Also during these intervals of southward field, regions of apparently rapidly varying currents were encountered within the cusp. Associated with these regions were enhanced VLF electric field levels. When the interplanetary field was northward, quasi-monochromatic Pc 1 waves close to but below the proton gyrofrequency and energetic electrons (E > 50 kev) were observed. Most of these observations are consistent with the existence of merging of the interplanetary magnetic field with the dayside magnetospheric field when the interplanetary field is southward and the absence of merging when it is northward. The dependence of electron temperature on field direction remains unexplained. (auth)

6007 ON THE STRUCTURE OF THE MAGNETOTAIL CURRENT SHEET. Kan, J.R. (Geophysical Institute, University of Alaska, Fairbanks, Alaska, 99701). J. Geophys. Res. 78: No. 19, 3773-3781 (1 July 1973).

A self-consistent tail current sheet model described by an exact analytic solution of the time independent Vlasov–Maxwell equations is presented. The model has a 'slingshot' field configuration with field lines outside the plasma sheet slightly flared in the antisolar direction. It is pointed out that when the model parameters are adjusted to agree with the spatial variation along the tail the required thickness of the neutral sheet must be ∼2.5 R_E, instead of ≲1 R_E as indicated by observations. Furthermore, it is shown qualitatively that a considerable velocity shear must be present in the tail current sheet if the plasma sheet is indeed much thicker than the neutral sheet. (auth)

6008 SYNOPTIC SURVEY FOR THE NEUTRAL LINE IN THE MAGNETOTAIL DURING THE SUBSTORM EXPANSION PHASE. Nishida, A.; Nagayama, N. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro-ku, Tokyo 153, Japan). J. Geophys. Res. 78: No. 19, 3782-3798 (1 July 1973).

The magnetic structure of the magnetotail during the expansion phase of the substorm is examined by summarizing observations made at more than fifty different locations scattered over the (solar magnetoshperic) range of $0 \gtrsim x \gtrsim -65\ R_E$, $20 \gtrsim y \gtrsim -20\ R_E$, and $30 \gtrsim |z| \gtrsim 0\ R_E$. It is found that all across the local-time sector of $|y| \lesssim 15\ R_E$, the neutral line is formed somewhere between $x = -10$ and $-30\ R_E$ within ∼10 min of the onset of the substorm expansion phase. This is due to the severe weakening or disruption of the tail current inside $x \simeq -20\ R_E$. The neutral line continues to exist for about 1 hour, and its disappearance occurs almost as quickly as its formation. The role of the neutral line on the substorm process is discussed in the light of the above observation. (auth)

6009 ULF MAGNETIC FLUCTUATIONS IN THE PLASMA SHEET AS RECORDED BY THE EXPLORER 34 SATELLITE. Garrett, H.B. (Department of Space Science, Rice University, Houston, Texas, 77001). J. Geophys. Res. 78: No. 19, 3799-3805 (1 July 1973).

The Explorer 34 satellite was used as a platform for studying ultralow-frequency (ULF) magnetic waves from 0.01 to 0.2 Hz in the plasma sheet. The power spectral density was found to be proportional to the inverse square of the frequency in the plasma sheet and exhibited few, if any, sign ificant spectral peaks. Further, the plasma sheet was characterized by power spectral density values that were higher than those of the high-latitude tail. The X_{sm} component, where the subscript sm indicates solar magnetospheric coordinates, exhibited greater power spectral density values than the other two components. The most significant result, however, was that the power spectral density calculated for the frequency range 0.012–0.1 Hz in the plasma sheet increased from minimal values during quiet times to maximum levels during the later stages of a substorm. It is shown that this result, in the frequency range studied, is probably inconsistent with the expectations of the substorm model of Hill and Dessler (1971), in which the plasma sheet was contained, during quiet times, by magnetic fluctuations. (auth)

6010 INTERACTION BETWEEN HIGH-FREQUENCY TURBULENCE AND MAGNETOSPHERIC MICROPULSATIONS. Hagège, K.; Laval, G.; Pellat, R. (Centre de Physique Théorique de l'Ecole Polytechnique, Paris, France). J. Geophys. Res. 78: No. 19, 3806-3815 (1 July 1973).

The quasi-linear interaction between a high-frequency whistler noise and a drift wave is considered as a possible explanation of the micropulsations observed during the magnetospheric substorms. The drift wave is a so-called ion trapped mode that propagates in a direction almost perpendicular to the magnetic field and has a frequency lower than the ion bounce frequency. Plasma pressure and field line curvature are taken into account in the general frame of the Vlasov equation. The drift wave interacts with the high-frequency turbulence by inducing anisotropy in the electron distribution function. As an example, growth rates and polarizations are computed for frequencies in the range of the Pc 5 micropulsations and compared to the observations. (auth)

6011 ULF GEOMAGNETIC POWER NEAR L=4. 1. QUIET DAY POWER SPECTRA AT CONJUGATE POINTS DURING DECEMBER SOLSTICE. Lanzerotti, L.J.; Robbins, M.F. (Bell Laboratories, Murray Hill, New Jersey, 07974). J. Geophys. Res. 78: No. 19, 3816-3827 (1 July 1973).

Hourly determinations of the power spectra of the ULF geomagnetic disturbances in the period band of ∼30–512 sec have been made from data obtained at conjugate points near L=4 on 3 consecutive days during the December solstice when ΣKp=2-, 0, and 1 (January 7, 8, and 9, 1971, respectively). The data from January 8 (ΣKp=0) are presented in detail in order to study ULF geomagnetic conditions during a time interval defined as 'quiet' by current measures of geomagnetic activity (i.e., the K index). The slope s of the frequency dependence of the power density log $\beta \propto -s \log f$ is found to vary from ∼–1.0 to ∼–2.5 during the day for both the H and D components. The magnetic power at the conjugate points shows a diurnal dependence with higher intensities during local day at both conjugate stations. The power densities β are most conjugate during local day; during local night, when the southern station (Siple, Antarctica) is in continual daylight, the power density is largest at Siple. This relationship holds on the average for all 3 quiet days. A portion of the diurnal dependence of the conjugacy of the power may be associated with the Sq current system through field-aligned currents, even though the Sq fields at the conjugate stations are observed to be strongly nonconjugate. (auth)

6012 HYDROMAGNETIC EIGENOSCILLATIONS IN THE MAGNETOSPHERIC TAIL. Tamao, T. (Geophysics Research Laboratory, University of Tokyo, Tokyo, Japan). J. Geophys. Res. 78: No. 19, 3965-3969 (1 July 1973).

Hydromagnetic eigenoscillations in the magnetotail were re-examined by using the appropriate boundary conditions and the presence of the high-β plasma sheet and slow magnetosonic waves within it are considered. (WDM)

6013 SIMULATION OF GYRORESONANT ELECTRON-WHISTLER INTERACTIONS IN THE OUTER RADIATION BELTS. Ossakow, S.L.; Ott, E.; Haber, I. (Naval Research Laboratory, Washington, D.C., 20375). J. Geophys. Res. 78: No. 19, 3970-3975 (1 July 1973).

In a previous work (Ossakow et al. 1973) the problem of whistler turbulence and velocity space diffusion in the magnetospheric plasma was studied by theory and computer simulation. This letter extends the previous work by presenting results of a new computer simulation experiment with parameters that are more realistic for the magnetosphere. (WDM)

6014 GEOMAGNETIC ACTIVITY AT SECTOR BOUNDARIES. Hirshberg, J. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, 80302); Colburn, D.S. J. Geophys. Res. 78: No. 19, 3952-3957 (1 July 1973).

The relation between the rise in geomagnetic activity at sector boundaries and the southpointing component of the interplanetary field is investigated. It is shown that, in 1968, an increase in the average southward component occurred when the sector boundary was crossed. This increase can account for the initial increase in magnetic activity. However, the southward component rapidly fell to its preboundary levels, while geomagnetic activity remained elevated for at least a day. This observation suggests that either the magnetosphere took of the order of a day to relax or energy continued to be fed into the magnetosphere at an enhanced rate during the postboundary period. A possible cause of the increase in southward fields at sector boundaries is discussed. (auth)

6015 REPLY. Heppner, J.P. (Laboratory for Space Physics, Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 19, 4003-4004 (1 July 1973).

The author discusses briefly each of the points raised by Russell and Atkinson in their comments. (WDM)

6016 COMMENTS ON A PAPER BY J. P., HEPPNER, 'Polar CAP ELECTRIC FIELD DISTRIBUTIONS RELATED TO INTERPLANETARY MAGNETIC FIELD DIRECTION'. Russell, C.T. (Institute of Geophysics and Planetary Physics, University of California, 90024); Atkinson, G. J. Geophys. Res. 78: No. 19, 4001-4002 (1 July 1973).

On the correlation between the polar cap electric field and the interplanetary electric field, Heppner (1972) states that there is little in common between the OGO-6 polar cap electric field patterns and the simple predictions based on field line merging mechanisms. This statement is felt to be not precisely true, and it is pointed out that simple predictions based on merging qualitatively agree with the OGO-6 results. (WDM)

6017 EFFECTS OF INTERPLANETARY MAGNETIC SECTOR STRUCTURE ON AURORAL ZONE AND POLAR CAP MAGNETIC ACTIVITY. Burch, J.L. (NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 7, 1047-1057 (1 Mar 1973).

For quiet (C9 ≤ 2) and quiet to moderately disturbed (C9 ≤ 4) conditions in the period 1964–1968, the following sector structure dependence of auroral zone positive and negative bay activity, as measured by the AE components AU and AL is noted. (1) There is a broad summertime peak in AU for both sector polarities, with AU higher for toward sectors the first half of the year and with no apparent sector dependence during the second half of the year. (2) A stronger sector dependence is evident for AL, which peaks for toward sectors in the spring and for away sectors in the fall. (3) In a single 6-month period, negative bay magnitudes at College and at its southern hemisphere conjugate station, Macquarie Island, followed the same sector dependence as AL. (4) During this same period the ratio of College to Macquarie Island negative bay magnitudes was higher for away sectors than for toward sectors, and this asymmetry persisted through the midwinter crossover in sector dependence that occurred for each individual station. A similar N–S asymmetry is found in the polar cap. The ratio of DP 2 type activity at Vostok to that at Thule was greater by a factor of about 1.75 for toward sectors than for away sectors for periods near the 1967 spring and fall equinoxes. (auth)

6018 OBSERVATIONS OF RING CURRENT PROTONS AT LOW ALTITUDES. Mizera, P.F.; Blake, J.B. (Space Physics Laboratory, The Aerospace Corporation, Los Angeles, California, 90009). J. Geophys. Res. 78: No. 7, 1058-1062 (1 Mar 1973).

Variable intensities of geomagnetically trapped protons with energies between 12.4 and 500 kev were observed during times encompassing the magnetic storms on March 20 and 24, 1969. These proton fluxes were measured for $1.0 < L < 1.1$ near the magnetic equator at local midnight with solid state detectors and an electrostatic analyzer on the low-altitude satellite OV1-17. Marked increases of proton intensities at energies below 100 kev occurred during this magnetically disturbed period. In contrast, proton intensities with $E > 200$ kev were observed to be a relatively stable and permanent feature of this region of the near-earth magnetosphere. The altitude range for these measurements was 400–470 km, a region where the atmospheric density is such that charge exchange lifetimes are comparable with the bounce period and short in relation to the longitudinal drift period. The OV1-17 observations of proton intensities with $E > 200$ kev are in substantial agreement with similar measurements taken with the Azur satellite and reported recently by Moritz (1972). Further, the lower-energy proton intensities, measured with OV1-17 instrumentation, support Moritz's suggestion that the source of these low-altitude protons is the ring current. (auth)

6019 ELECTRON PITCH ANGLE DISTRIBUTIONS THROUGHOUT THE MAGNETOSPHERE AS OBSERVED ON OGO 5. West, H.I. Jr.; Buck, R.M.; Walton, J.R. (Lawrence Livermore Laboratory, University of California, Livermore, California, 94550). J. Geophys. Res. 78: No. 7, 1064-1081 (1 Mar 1973).

A survey of the equatorial pitch angle distribuions of energetic electrons is provided for all local times out to radial distances of 20 R_E on the night side of the earth and to the magnetopause on the day side of the earth, the normal loss cone distribution prevails. The effects of drift shell splitting (that is, the appearance of pitch angle distributions with minimums at 90°, called butterfly distributions) become apparent in the early afternoon magnetosphere at extended distances, and the distribution is observed in to 5.5 R_E in the nighttime magnetosphere. Inside ∼ 9 R_E the pitch angle effects are quite energy dependent. Beyond ∼ 9 R_E in the premidnight magnetosphere during quiet times the butterfly distribution is often observed with $j_\perp^{2.3} / j_\parallel < 1/100$. It is shown that these electrons cannot survive a drift to dawn without being considerably modified. The role of substorm activity in modifying these distributions is identified. (auth)

6020 HIGH-FREQUENCY ELECTROSTATIC WAVES IN THE MAGNETOSPHERE. Young, T.S.T. (Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts, 02139); Callen, J.D.; McCune, J.E. J. Geophys. Res. 78: No. 7, 1082-1099 (1 Mar 1973).

High-frequency electrostatic microinstabilities in magnetospheric plasmas are considered in detail. Rather special plasma parameters are found to be required to match the theoretical wave spectrum with satellite observations in the magnetosphere. In particular it is necessary to have a cold and a warm species of electrons such that (1) the warm component has an anomalous velocity distribution function that is nonmonotonic in $v_\perp$ and is the source of free energy driving the instabilities, (2) the density ratio of the cold component to the hot component is greater than about 10^{-2}, and (3) the temperature ratio of the two components for cases of high particle density is no less than 0.1. These requirements and the corresponding instability criteria are satisfied only in the trapping region ($4 \leq L \leq 10$); this is also the region in which the waves are most frequently observed. The range of unstable wavelengths and an estimate of the diffusion coefficient are also obtained. The waves are found to induce strong diffusion in velocity space for low-energy electrons (≲ 1 kev) during periods of moderate wave amplitude (≲ 10 mv/m). Electrons with energies of up to 100 kev can be strongly diffused when the wave amplitude is large (∼100 mv/m). Geophysical implications are discussed; predicted results compare favorably with available observations pertaining to electrostatic waves,

the particle distribution function, particle acceleration, and pitch angle diffusion in the magnetosphere. (auth)

6021 NONADIABATIC PARTICLE MOTION IN THE MAGNETOSPHERE. Morfill, G. (Max–Planck–Institut für Physik und Astrophysik, Institut für extraterrestriche Physik, Munich, Germany). J. Geophys. Res. 78: No. 4, 588-596 (1 Feb 1973).

Using calculations in a model geomagnetic field, the influence of nonadiabatic particle motion on the polar cap structure of solar protons is investigated. Breakdown of the first invariant, due to excessive field curvature and gradients near the last closed field line, results in an effect that cannot be differentiated from strong pitch angle scattering using low–altitude detectors, although no time variations of the magnetic field are considered. The results obtained thus form a basis to which wave–particle interactions and other scattering effects must be added. In a companion paper, these results are applied to observations of solar protons over the polar caps, and it is shown that the quiettime behavior of these particles is indeed approximately given by the constraints due to the spatial variations of the geomagnetic field. (auth)

6022 LOW–ENERGY SOLAR PROTONS IN THE PSEUDO–TRAPPING REGION OF THE MAGNETOSPHERE. Bewick, A.; Haskell, G.P.; Hynds, R.J. (Department of Physics, Imperial College of Science and Technology, London, England); Morfill, G. J. Geophys. Res. 78: No. 4, 597-606 (1 Feb 1973).

The development of structure in the flux profiles of low–energy (≈2–MeV) solar protons at low altitudes over the polar caps is examined in detail for the event beginning on June 9, 1968. The structure is studied in the frame of reference provided by simultaneous measurements of the trapping boundary for electrons of energy >1.2 MeV and calculations of the boundary of the pseudo–trapping region. The results are interpreted in terms of (1) delayed access of solar protons to the magnetotail, (2) an effect indistinguishable from strong pitch angle scattering near the last closed field lines, owing to breakdown of the adiabatic invariants in the strong curvature of the magnetic field, (3) weak pitch angle scattering on the dayside at low latitudes in the pseudo–trapping region and in the stable–trapping region, and (4) inward diffusion and acceleration in the stable–trapping region. (auth)

6023 PROTON SCATTERING IN THE REGION NEAR THE EARTH'S BOW SHOCK. Ossakow, S.L. (U.S. Naval Research Laboratory, Washington, D.C., 20390); Sharp, G.W. J. Geophys. Res. 78: No. 4, 607-616 (1 Feb 1973).

Lockheed spectrometer data from orbits 1 through 20 of Ogo 5 are used to study proton scattering near the bow shock. Correlative UCLA fluxgate magnetometer data from the satellite are used to complete motion studies of the bow shock when spectrometer data are missing. Thirty–eight analyzable sets of multiple shock crossings show 358 shock encounters ranging from $r=10\ R_E$ to $r=22\ R_E$ and spanning sun–earth–satellite angles from 30° to 90°. Gross features of the study show that the location and shape of the bow shock are in good agreement with the hydrodynamic model of the bow shock. On a microscale the protons are slowed and scattered, having concomitant randomization of velocity vectors as they traverse the bow shock layer. A change in directed proton flux is noted, and study of the available spectrometer data shows a c/ω_{pi} scale length for proton scattering, where the Ogo 5 JPL plasma probe density measurements have been used. This scale length is based upon the time required for scattering the protons into the wings of the velocity distribution and may not be representative of the time required for proton heating. (auth)

6024 WHISTLER OBSERVATIONS OF THE DEPLETION OF THE PLASMASPHERE DURING A MAGNETOSPHERIC SUBSTORM. Park, C.G. (Radioscience Laboratory, Stanford University, Stanford, California, 94305). J. Geophys. Res. 78: No. 4, 672-683 (1 Feb 1973).

Whistlers recorded in Antarctica and North America were used to monitor changes in electron concentrations in the dayside plasmasphere during isolated substorm activity. The 'viewing area' of the whistler receiver network extended over $L\approx 2$ to 6 and ≈6 hours in geomagnetic time. Before the substorm, the plasmasphere was relatively full and smooth, and there was no evidence of large longitudinal variations in plasma distribution. Immediately after the substorm onset, parts of the plasmasphere were depleted rapidly and produced large–scale structures with sharp longitudinal gradients in plasma density. The depletion of the plasmaspheric tubes is interpreted in terms of downward flow of plasma into the underlying ionosphere, and fluxes of the order of 10^9 el/cm² sec across the 1000 km level are inferred. Simultaneous ionosonde records show enhanced critical frequencies in the underlying F_2 layer. These results indicate that significant amounts of plasma in the plasmasphere are dumped into the ionosphere during geomagnetic disturbances and that this is an important process in storm phenomena in both regions. (auth)

6025 FINE STRUCTURE OF Pc 1 PULSATIONS 1. EXPERIMENTAL EVIDENCE. Wehrlin, N.; Gendrin, R.; Roux, A. (Groupe de Recherches Ionosphériques, Centre National d'Etudes des Télécommunications, Issy–les–Moulineaux, France); Welti, R. J. Geophys. Res. 78: No. 4, 763-768 (1 Feb 1973).

The experimental results of a detailed frequency analysis of Pc 1 events are given. The frequency separation of the different lines was measured as well as the variation of intensity with time of each of these lines. (WDM)

6026 NONLINEAR THEORY OF PLASMA INSTABILITY AT $(n+1/2)\ \Omega_i$. Nambu, M. (Department of Physics, School of Medicine, Kyorin University, Tokyo, Japan). J. Geophys. Res. 78: No. 4, 769-771 (1 Feb 1973).

Naturally occurring emissions at $(n+1/2)\ \Omega_i$ observed by Ogo 5 near the geomagnetic equator outside the plasmapause are studied within the framework of nonlinear plasma theory. The nonlinear frequency correction to the previous Fredricks linear instability analysis is obtained. The splitting of frequency spectra does not occur for high–frequency cyclotron waves, in contrast to low–frequency drift waves. (auth)

6027 ELECTROSTATIC TURBULENT LOSS OF RING CURRENT PROTONS. Nambu, M. (Department of Physics, School of Medicine, Kyorin University, Tokyo, Japan). J. Geophys. Res. 78: No. 7, 1203-1205 (1 Mar 1973).

It is proposed that the electrostatic drift cyclotron loss cone waves are effective for the turbulent loss of ring current protons near and outside the plasmapause. (WDM)

6028 DETECTION OF SOLAR WIND AT SYNCHRONOUS ORBIT. DeForest, S.E. (Physics Department, University of California at San Diego, La Jolla, California, 92037). J. Geophys. Res. 78: No. 7, 1195-1197 (1 Mar. 1973).

A report is presented on the detection of unshocked solar wind by the Univ. of Cal., San Diego, plasma detector on ATS 5. This happened during the height of the March 8, 1970, geomagnetic storm when the spacecraft was near local noon. (WDM)

6029 MILLISECOND TIME SCALE ATMOSPHERIC LIGHT PULSES ASSOCIATED WITH SOLAR AND MAGNETOSPHERIC ACTIVITY. Ögelman, H. (Physics Department, Middle East Technical University, Ankara, Turkey). J. Geophys. Res. 78: No. 16, 3033-3039 (1 June 1973).

By using a wide–angle photomultiplier system a class of millisecond time scale diffuse atmospheric light emission of terrestrial origin has been discovered. These fast atmospheric pulsation events also show damped oscillations around 10–kHz frequency, which distinguishes them from ordinary lightning–type events. Evidence is presented for the enhancement in the rate of these events induced by solar flare activity. (auth)

6030 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 1. STATE OF THE MAGNETOSPHERE. McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024). J. Geophys. Res. 78: No. 16, 3044-3053 (1 June 1973).

The sequence of events occurring throughout the magnetosphere during a substorm has not been precisely determined. This paper introduces a collection of papers that attempts to establish this sequence for two substorms on August 15, 1968. Data from a wide variety of sources are used, the major emphasis being changes in the magnetic field. In this paper we use ground magnetograms to determine the onset times of two substorms that occurred while the Ogo 5 satellite was inbound on the midnight meridian through the cusp region of the geomagnetic tail (the region of rapid change from taillike to dipolar field). We conclude that at least two worldwide substorm expansions were preceded by growth phases. Probable beginnings of these phases were at 0330 and 0640 UT. However, the onset of the former growth phase was partially obscured by the effects of a preceding expansion phase around 0220 and a possible localized event in the auroral zone near 0320 UT. The onsets of the corresponding expansion phases were 0430 and 0714 UT. Further support for these determinations is provided by data discussed in the subsequent notes. (auth)

6031 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 2. SOLAR WIND AND OUTER MAGNETOSPHERE. McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024); Parks, G.K.; Colburn, D.S.; Montgomery, M.D. J. Geophys. Res. 78: No. 16, 3054-3061 (1 June 1973).

We continue the study of the sequence of events occurring in the magnetosphere during several substorms on August 15, 1968. We show that the onsets of expansion phases identified in the preceding paper at 0220, 0430, and 0714 UT were each preceded by almost an hour of southward solar wind magnetic field. During the entire interval containing these substorms there was no significant change in the solar wind velocity. Intermittent observations of the solar wind particle density and temperature suggest there were no large changes in the

dynamic and static pressure. The fact that the solar wind field remained southward after the onsets of two substorm expansions is interpreted as evidence that the expansion is a process internal to the magnetosphere. However, coincidence of an expansion onset with a large fluctuation of the solar wind field makes it impossible to rule out the possibility that the expansion can be triggered externally. Magnetic field observations in the premidnight sector of the synchronous equatorial orbit show that the earth's field here begins to decrease in response to the beginning of the southward solar wind field. Throughout the interval prior to the onset of the expansion (growth phase) the field continues to decrease. During one of the substorms, energetic electron precipitation was observed during this growth phase. In the expansion phase the field at synchronous orbit recovers. (auth)

6032 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 3. SOME FEATURES OF MAGNETOSPHERIC CONVECTION. Carpenter, D.L. (Radioscience Laboratory, Stanford University, Stanford, California, 94305); Chappell, C.R. J. Geophys. Res. 78: No. 16, 3062-3067 (1 June 1973).

A combination of Ogo 4 and 5 data and ground data for August 13–15, 1968, has revealed new details of unsteady magnetospheric convection and the gradual erosion of the plasmasphere during a weak magnetic storm. Evidence of erosion was detected by Ogo 5 in the form of complex density structure near the duskside plasmapause and by Ogo 4 as a persistent diminution in plasmapause L value near 0500 magnetic local time (MLT). Evidence of unsteady convection includes (1) Ogo 5 observations of the irregular duskside density profile, (2) Ogo 4 and Byrd ground whistler observations of an apparent rotation of the plasmasphere bulge during quieting, and (3) Ogo 4 observations near 0550 MLT of fluctuations of plasmapause L value around the slowly decreasing average value. It is inferred that most of the variations in plasmapause L value observed near 0500 MLT were the result of rotation under the satellite of spatial patterns imposed by convection activity in the midnight and dusk sectors. A pronounced decrease in plasmapause L value from $L \approx 3.4$ to $L \approx 2.5$ followed within a few hours the major substorms of early August 15. From the size of this decrease, and from previous whistler research on cross-L plasma drifts, it is inferred that westward electric fields of the order of 0.5 mv/m were present in the midnight sector during the substorms of interest. (auth)

6033 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 4. OGO 5 MAGNETIC FIELD OBSERVATIONS. McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, Univeristy of California, Los Angeles, California, 90024); Aubry, M.P.; Rusbell, C.T.; Coleman, P.J. Jr. J. Geophys. Res. 78: No. 16, 3068-3078 (1 June 1973).

In this paper we examine the changes in the magnetic field on the midnight meridian 15–8 R_E behind the earth. These changes are conveniently divided into two main phases: a growth phase and an expansion phase. The beginnings of the growth phase coincide within experimental error to the arrival of a southward solar wind magnetic field at the dayside magnetopause and also to the beginning of the growth phase at synchronous orbit and ground observatories. During the growth phase the magnitude of the field increases in the lobe of the tail. In the cusp both the magnitude and the inclination of the field increase. Slow changes in the cross-tail field accompany these effects. Nearly coincident with the onset of the polar substorm the lobe field magnitude begins to decrease, the cusp field magnitude and inclination decrease, and there are sudden changes in the cross-tail field. About this time the plasma sheet begins to expand. Inside the expanding plasma sheet and associated with the field rotation are large fluctuations in the field. The response of the field at 8 R_E was simultaneous with the ground onset, whereas further back at 11.3 and 2.4 R_E above the expected neutral sheet the largest changes were delayed by 15 min. (auth)

6034 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 5. ENERGETIC ELECTRONS, SPATIAL BOUNDARIES, AND WAVE-PARTICLE INTERACTIONS AT OGO 5. Kivelson, M.G.; Farley, T.A.; Aubry, M.P. (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024). J. Geophys. Res. 78: No. 16, 3079-3092 (1 June 1973).

An examination of measurements of the flux of energetic electrons in the near magnetotail during two well-defined substorms on August 15, 1968, gives evidence that the boundary of the region in which energetic electrons are present moves inward during the growth phase and outward during the expansion phase of a substorm. An estimate of the velocity of inward motion yields ≈ 10 km sec^{-1}. Pitch angle distributions are examined, and distributions peaked in a direction perpendicular to the magnetic field are shown in this event to be associated with ELF magnetic noise. During the expansion phase an interval of rapidly changing magnetic field is shown to be accompanied by betatron acceleration of electrons. (auth)

6035 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 6. OGO 5 ENERGETIC ELECTRON OBSERVATIONS–PITCH ANGLE DISTRIBUTIONS IN THE THE NIGHTTIME MAGNETOSPHERE. West, H.I. Jr.; Buck, R.M.; Walton, J.R. (Lawrence Livermore Laboratory, University of California, Livermore, California, 94550). J. Geophys. Res. 78: No. 16, 3093-3102 (1 June 1973).

The electron pitch angle distributions during the 0714 UT August 15, 1968, substorm are examined and contrasted with the pitch angle distributions of electrons obtained during a magnetically quiet period. As is characteristic of a quiet period, we find the butterfly pitch angle distribution just prior to the onset of the substorm growth phase at 0640 UT, at which time the magnetic field began to become more taillike. The electrons made energy-dependent transitions to isotropy with the higher-energy groups changing earliest. The omnidirectional electron spectrum and fluxes did not change appreciably during this transition from butterfly to isotropy. The electron fluxes gradually decreased by a factor of about 300 as the plasma sheet moved away from the position of Ogo 5. Expansion came at 0714 UT, the pitch angle distributions still showing approximate isotropy. The butterfly pitch angle distribution of electrons re-emerged as fresh electrons drifted into the midnight region on dipole like field lines. There is a strong indication that the magnetic field configuration is the dominant factor in determining the pitch angle forms during the course of the substorm. (auth)

6036 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 7. OGO 5 ENERGETIC PROTON OBSERVATIONS-SPATIAL BOUNDARIES. Buck, R.M.; West, H.I. Jr. (Lawrence Livermore Laboratory, University of California, Livermore, California, 94550); D'Arcy, R.G. Jr. J. Geophys. Res. 78: No. 16, 3103-3118 (1 June 1973).

Directional proton fluxes (0.1–0.8 Mev) observed at pitch angles near 90° to B during the growth phase of the 0714 UT August 15, 1968, substorm showed a strong east–west asymmetry. Since the Ogo 5 spacecraft was in the north edge of the midnight plasma sheet in a taillike magnetic field, the Lawrence Livermore Laboratory (LLL) spectrometer observed westward-directed fluxes having their gyrocenters located south of the satellite deeper in the sheet and eastward-directed fluxes having their gyrocenters north of the satellite toward the sheet boundary. We have used the directional flux variation to determine the flux profile north to south of Ogo 5 over $\approx \pm 0.4$ R_E approximately every 2 min during the substorm growth phase, 0640–0714 UT. At 0610 UT, before the substorm, the e fold length of the flux gradient was ≈ 1.3 R_E, which slowly changed to ≈ 1.0 R_E at 0640 UT, the start of the substorm growth phase. A thinning wave developed north of Ogo 5, showing an e fold length of ≈ 0.1 R_E at 0700 UT, which dropped to ≈ 0.03 R_E as the thinning wave passed south of the orbit of Ogo 5 just before the onset of expansion. The data suggest that the plasma sheet at ≈ 8 R_E had shrunk from a half-thickness of > 1.5 R_E before the substorm to a few tenths of an earth radius. The velocity of the thinning wave perpendicular to B was found to vary from ≈ 4 km/sec at 0655 UT early in the growth phase to a peak of 10 km/sec just before expansion. The velocity of outward expansion of the plasma sheet in a direction inclined $\approx 45°$ to the GSM equator was estimated as 90 ± 30 km/sec. (auth)

6037 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 8. OGO 5 PLASMA WAVE OBSERVATIONS. Scarf, F.L.; Fredricks, R.W. (Space Sciences Laboratory, TRW Systems Group, Redondo Beach, California, 90278); Kennel, C.F.; Coroniti, F.V. J. Geophys. Res. 78: No. 16, 3119-3130 (1 June 1973).

We demonstrate that during the expansion phase of each of the three substorms detected by Ogo 5 on August 15, 1968, the plasma wave experiment detected significantly enhanced wave levels. For the two substorms encountered when Ogo was far downstream from earth, the peak turbulence levels were moderate. However, extremely intense signals were detected during the third substorm, when Ogo was closer to earth on auroral L shells. At this time the dominant electric field emission was one with wave frequency near 1.5 times the local electron gyrofrequency, although significant chorus signals were also present later in the expansion phase. We demonstrate that the maximum electric field intensities were sufficiently high to produce strong diffusion for energetic electrons, and we present evidence suggesting that this wave-particle interaction was operative, so that the waves controlled the local pitch angle distributions. (auth)

6038 SATELLITE STUDIES OF MAGNETOSPHERIC SUBSTORMS ON AUGUST 15, 1968 9. PHENOMENOLOGICAL MODEL FOR SUBSTORMS. McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, 90024); Russell, C.T.; Aubry, M.P. J. Geophys. Res. 78: No. 16, 3131-3149 (1 June 1973).

In the eight preceding papers, two magnetospheric substorms on August 15, 1968, were studied with data derived from many sources. In

this, the concluding paper, we attempt a synthesis of these observations, presenting a phenomenological model of the magnetospheric substorm. On the basis of our results for August 15, together with previous reports, we believe that the substorm sequence can be divided into three main phases: the growth phase, the expansion phase, and the recovery phase. Observations for each of the first three substorms on this day are organized according to this scheme. We present these observations as three distinct chronologies, which we then summarize as a phenomenological model. This model is consistent with most of our observations on August 15, as well as with most previous reports. In our interpretation we expand our phenomenological model, briefly described in several preceding papers. This model follows closely the theoretical ideas presented more quantitatively in recent papers by Coroniti and Kennel (1972a, b; 1973). A southward turning of the interplanetary magnetic field is accompanied by erosion of the dayside magnetosphere, flux transport to the geomagnetic tail, and thinning and inward motion of the plasma sheet. Our observations indicate, furthermore, that the expansion phase of substorms can originate near the inner edge of the plasma sheet as a consequence of rapid plasma sheet thinning. At this time a portion of the inner edge of the tail current is 'short circuited' through the ionosphere. This process is consistent with the formation of a neutral point in the near-tail region and its subsequent propagation tailward. However, the onset of the expansion phase of substorms is found to be far from a simple process. Expansion phases can be centered at local times far from midnight, can apparently be localized to one meridian, and can have multiple onsets centered at different local times. Such behavior indicates that, in comparing observations occurring in different substorms, careful note should be made of the localization and central meridian of each substorm. (auth)

6039 SELF-CONSISTENT CALCULATION OF THE MOTION OF A SHEET OF IONS IN THE MAGNETOSPHERE. Jaggi, R.K.; Wolf, R.A. (Department of Space Science, Rice University, Houston, Texas, 77001). J. Geophys. Res. 78: No. 16, 2852-2866 (1 June 1973).

Time dependent magnetospheric electric fields have been computed, including the effects of Birkeland currents from the inner edge of a sheet of ions that moves under the influence of the computed electric fields. Ionospheric currents are also taken self-consistently into account with the use of a time-independent model of ionospheric conductivity that includes day-night asymmetry and auroral enhancements but neglects electric fields parallel to the magnetic field. Ion precipitation and neutral winds are also neglected. The behavior and effects of the ion sheet are studied in a series of model calculations, with the following results. (1) In agreement with the conclusions of E. T. Karlson, L. P. Block, V. M. Vasyliunas, and D. W. Swift, Birkeland currents from the Alfvén layer (inner edge of the ion sheet) are found to reduce the electric field earthward of the Alfvén layer to a small value by the time a steady state is reached; however, different parts of the electric field earthward of the Alfvén layer are eliminated at different rates; one component of the nightside field relaxes to near its low asymptotic value in a few minutes, whereas the dayside field takes hours to relax. (2) If the ion sheet is brought in from the tail by a large cross-tail electric field that stays large, the inner edge of the sheet generally touches the magnetopause boundary layer; however, a decrease in the cross-tail field can cause the Alfvén layer to contract and form a complete ring. (3) For the parameters used, a cross-tail potential of 134 kv will bring a sheet of ring current protons in to about L=4; the results of the model calculations support the idea that convection electric fields bring low-energy ions in from the tail to form the storm time ring current; the minimum geocentric distance to which convection fields can bring the ions is found to be roughly proportional to $(\eta\mu/\Phi_0\sigma_p)^{1/3}$, where η is the number of ions per unit magnetic flux, μ is the ion magnetic moment, Φ_0 is the cross-tail potential, and σ_p is an average height-integrated Pedersen conductivity on the dayside. (4) The nightside Alfven layer naturally produces a dividing line near local midnight, such that particles arriving west of the line drift to the west, whereas those arriving east of the line drift east; this characteristic is often observed in motions of barium clouds and auroral arcs. (auth)

6040 ELECTRON PRECIPITATION PATTERNS AND SUBSTORM MORPHOLOGY. Hoffman, R.A.; Burch, J.L. (NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 16, 2867-2884 (1 June 1973).

Patterns of the precipitation of low-energy electrons observed by polar satellites have been examined as functions of substorm phase. Precipitation boundaries are generally identifiable at the low-latitude edge of polar cusp electron precipitation and at the poleward edge of precipitation in the premidnight sector (1800-2300 MLT). Both of these boundaries move equatorward when the interplanetary magnetic field (IMF) turns southward. Intense spikes of 2.3-kev electron occurred in all quiet (IMF south) or growth phase cases in the premidnight region. The premidnight precipitation boundary remains at the same latitude on the average throughout the growth and expansion phases. However, during the expansion phase, localized bands of intense 7.3-kev electrons are observed in the premidnight sector. Near and just after midnight, intense 7.3-kev precipitation occurs over ≈10° of latitude with a clear separation between lower-latitude diffuse and higher-latitude structured precipitation. During the recovery phase the diffuse band of energetic electrons, which first appeared near midnight, drifts through the morning hours to near noon, producing the mantle aurora. The high-latitude boundary of these drifting electrons occurs at higher latitudes for northward IMF and at lower latitudes for southward IMF. During the postrecovery phase with northward IMF, the polar cusp and premidnight precipitation boundaries are again found at their quiet phase locations, but the diffuse band of drifting high-energy electrons continues to precipitate with the mantle aurora excitation continuing throughout the several hours requried for the electrons to drift from midnight to noon. The high-latitude precipitation boundary at 1800-2300 MLT is much sharper in the growth and expansion phases than can be explained by any observed plasma sheet gradients. It is concluded that a sharp boundary to closed field lines exists in the tail, perhaps as an X-type neutral line, throughout the growth and expansion phases. The statistical stability of the high-latitude precipitation boundary indicates that the postulated X-type neutral line is stationary in terms of the total flux of closed magnetic field lines that it defines. (auth)

6041 ULTRALOW FREQUENCY FLUCTUATIONS AT THE POLAR CUSP BOUNDARIES. D'Angelo, N. (Danish Space Research Institute, Lyngby, Denmark). J. Geophys. Res. 78: No. 7, 1206-1209 (1 Mar 1973).

ULF magnetic fluctuations observed by Ogo 5 at the polar cusp boundaries are analyzed in terms of a drift wave instability and a Kelvin-Helmholtz instability. The latter appears to account for the observed propteries of the fluctuations. The relevance of this instability to the low-altitude structure of the polar cusp is briefly discussed. (auth)

6042 FREQUENCY-DIRECTION ANALYSIS OF GEOMAGNETIC PULSATIONS. Part II. Pulsations pc3 (Bpc3). Prikner, K.; Strestik, J.; Dobes, K. (Geophysical Inst., Prague). Stud. Geophys. Geod.; 17: No. 4, 337-345(Oct 1973).

Using the method of two-component spectral analysis of planar oscillation events by means of computer processing of A-t records, a series of about 100 samples of geomagnetic beating-type pulsations pc3 was treated. The quantitative data obtained on the internal structure of the pulsations (frequency spectra and polarization characteristics) were treated statistically. The pattern of the daily variations of the frequencies and amplitudes of the fundamental amplitude-dominating frequency components of the pulsations and the daily variations of the polarization characteristics of these components, the ellipticity of the polarization ellipses, the directions of the main axes of these ellipses and the sense of rotation of the disturbance vector along the ellipses were obtained. (auth)

6043 ASSOCIATION OF MAGNETOSPHERIC WHISTLER DISPERSION CHARACTERISTICS WITH CHANGES IN LOCAL PLASMA DENSITY. Scarf, F. L. (Space Sciences Dept., Redondo Beach, CA); Chappell, C. R. J. Geophys. Res.; 78: No. 10, 1597-1602(1 Apr 1973).

Ogo 5 measurements made within the plasmapause on May 15, 1969 are used to investigate the possible association between changes in lightning whistler dispersion characteristics and local density fluctuations. It is shown that groups of whistlers with relatively constant dispersions tended to be detected in regions where the local ion concentration was significantly enhanced. It is assumed that these local density fluctuations represent characteristics of large-scale field-aligned variations. The results are then compared with ray refraction estimates appropriate for low-frequency whistler mode propagation (wave components with frequencies comparable to the local lower hybrid frequency) in a nonuniform medium. (auth)

6044 MICROPULSATIONS RECORDED BY AN ARRAY OF MAGNETIC VARIOMETERS. Lilley, F. E. M.; Bennett, D. J. (Australian National Univ., Canberra). J. Geophys. Res.; 78: No. 10, 1603-1607(1 Apr 1973).

Data recorded at 10-sec intervals by an array of 25 Gough-Reitzel magnetic variometers have been studied for micropulsation activity. The instruments operated simultaneously over an area approximately 500 × 750 km in SE Australia, each instrument recording three components of the geomagnetic variation field. Concurrent recording by the instruments of several cycles of activity of 7 min period has enabled us to map the large-scale spatial variation of the micropulsation components. The resulting patterns are quite smooth; the strongest effect is the spatial variation of the vertical component, which exhibits a "coast effect" similar to that observed at longer periods. Micropulsation data recorded by arrays of such instruments may yield valuable information on crustal conductivity structure. (auth)

6045 MAGNETIC CONTROL OF THE NEAR EQUATORIAL NEUTRAL THERMOSPHERE. Hedin, A. E.; Mayr, H. G. (God-

dard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 10, 1688-1691(1 Apr 1973).

Neutral density data between 400 and 500 km obtained with the Ogo 6 neutral mass spectrometer indicate that at all longitudes the daytime N_2 and O densities have latitudinal minimums at the magnetic equator that are about 20 and 10%, respectively, below maximums observed at ±20° magnetic latitude. The calculations suggest that this anomaly could result from latitudinal variations in ion drag associated with the "equatorial anomaly" in F region ionization. At latitudes of enhanced electron density the energy flow from the dayside to the nightside of the earth is damped, and thus the amplitude of the temperature and density variations is enhanced, and the time of maximum is shifted to later local times. (auth)

6046 PLASMASPHERIC HISS. Thorne, R. M. (Univ. of California, Los Angeles); Smith, E. J.; Burton, R. K.; Holzer, R. E. J. Geophys. Res.; 78: No. 10, 1581-1596(1 Apr 1973).

A relatively steady band of ELF hiss was detected by the Ogo 5 search coil magnetometer on almost every passage through the plasmasphere; except for an anomalous region on the dayside at high geomagnetic latitudes, the emissions terminate abruptly at the plasmapause, and therefore are referred to as "plasmaspheric hiss." A preliminary statistical study of the properties of the observed whistler mode turbulence has yielded the following characteristics: the waves are band limited with a sharp lower-frequency cutoff and a more diffuse upper-frequency cutoff; power spectra show a well-defined maximum near a few hundred hertz, the peak intensities generally ranging between 10^{-7} and 10^{-5} γ^2/Hz; the wave energy is spread over a bandwidth of a few hundred hertz, and corresponding wide band amplitudes are 5 to 50 mγ; the waves are highly turbulent in nature and show little tendency of definite polarization. The above properties remain essentially constant throughout the plasmasphere. Observed properties of the hiss are consistent with generation at all local times in a restricted L range just within the plasmapause. Waves subsequently propagate on complex paths to fill the plasmasphere. The most probable generation mechanism is cyclotron resonant instability with low-energy electrons that continually diffuse inward from the outer radiation zone. At lower L, hiss resonates with higher-energy electrons, and thus the electrons are scattered in pitch angle and hence lost to the atmosphere throughout the "slot" between the inner and outer radiation belts. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 5545, 5570, 6655, 6754, and 6759.

6047 (DNPL/NSF/R-5, pp 371-376) EXISTENCE OF DOUBLY NEGATIVE CHARGED IONS. Bethge, K. (Univ., Heidelberg). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

The question of whether doubly negative charged ions exist is discussed. If they have an existence it has been agreed that their lifetime is less than about 10^{-10}s, which is shorter than the transition time in ordinary atomic systems. Other conclusions have indicated about 10^{-4}s, long enough for observation. A description is given of experimental work done with a view to gaining some insight into possible formation processes, and results are discussed, including those obtained at the tandem accelerators of the Max-Plank Institute for Nuclear Physics, Heidelberg. Doubly negative charged ions were apparently observed for O, P, F, Cl, As, Br, Sb, Te, I and Bi. The fact that such ions have apparently been observed raises questions of a physical and technical nature. The atomic physicist would like to know what atomic configuration allows the formation of stable or metastable states of these ions; the nuclear physicist asks whether the beam intensity can be increased to a value such that an accelerated beam becomes realistic; and both interests cross in the question of what processes cause the production of these ions. These problems are briefly discussed, but none has been solved, and some not even tackled. From the present state of knowledge, what process dominates cannot be determined, but such information is essential for further improvements for higher beam current outputs. (UK)

6048 (DNPL/NSF/R-5, pp 392-400) NEW NEGATIVE ION SOURCE. Purser, K. H. (Univ. of Rochester, NY). 1973.

From international conference on the technology of electrostatic accelerators; Daresbury, England (4 May 1973).

Reference is made to the paper by Donnally and Thoeming (Phys. Rev. 159: 87(1967 in connection with the history of the production of useful beams of negative ions and the specific problem of He^- production. It is pointed out that there is no reason to limit matters to He^- production. The geometry of a Li ion source, that has been in operation at the University of Rochester for several years, is shown schematically. The principle of operation is that a heated boat supplies Li vapour, that coats the inside of a canal which is bombarded by He or Ar beam. Li ions sputtered by the incident particles travel through the surface layers and are charge exchanged to negative and accelerated. Currents in excess of 5μ have been produced, and the source has operated reliably between 2 and 4μA for periods of ten days or more. A similar source was constructed later to produce a wide variety of negative ions. The principle of operation is that an Ar beam from a standard duoplasmatron bombards the inner surface of a sputter core coated with Cs from an alkali metal evaporator. An electric field produced by cylindrical electrodes extends into the conical region to produce an electric extraction field that accelerates negative ions produced in the source and charge exchanged in the surface layer of the Cs or Li. A modification introduced was installation of a surface ionization source for K in place of the Ar duoplasmatron. The extraction cone was also mounted on a wheel so that it was possible to have up to 12 different species of negative ions available from a given source without breaking vacuum. The operation of surface ionization sources is described. Advantages of these types of sputter systems are summarized. (UK)

6049 (JINR-E2-7169) OSCILLATORY STRUCTURE OF THE $pe + d \rightarrow de + p$ TOTAL CHARGE-TRANSFER CROSS SECTION. Matveenko, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U.S. Sales Only) $3.00.

The two-state approximation of the perturbed stationary state method was used in calculation of charge-transfer cross section in reaction $pe + d \rightarrow de + p$, $0 < E \leq 1$ eV. Oscillatory structure of this cross section is analysed to some extent. (auth)

6050 DESTRUCTIVE INSTABILITIES IN HOLLOW INTENSE RELATIVISTIC ELECTRON BEAMS. Kapetanakos, C.A.; Hammer, D.A.; Striffler, C.D. (Naval Research Laboratory, Washington, D.C. 20375); Davidson, R.C. Phys. Rev. Lett. 30: No. 26, 1303-1306 (25 June 1973).

It is found that a 400-keV, 10-40-kA, 50-nsec duration hollow relativistic electron beam suffers from a severe instability when injected into neutral gas along a magnetic field. The dependence of beam distortion on beam thickness, magnetic field strength, beam current, and proximity of the surrounding conducting walls is experimentally studied. The experimental observations are consistent with the diocotron instability occurring during the first several nanoseconds of the beam pulse. (auth)

6051 MICROWAVE CAVITY ION SOURCE. Fremiot, C.; Grando, J. (to Commissariat a l'Energie Atomique). French Patent 2,147,497. 29 Jul 1971. 18p. (In French).

An ion source using a plasma produced by a device having a microwave cavity excited to one of its resonance modes by an electromagnetic field provided by a microwave generator is described. The source possesses a device for the injection of the gas (to be ionized), an expansion tank for extracting the plasma, an electrode for extracting the ions, and a means for the production of a static magnetic field in the cavity. The amplitude of this magnetic field is chosen so that the associated electron cyclotron resonance frequency is near the frequency of the electromagnetic field established in the microwave cavity. (FR)

6052 DOUBLE BEAM ION SOURCE. Ghander, A. M.; Fitch, R. K. (Univ. of Aston, Birmingham, Eng.). Vacuum; 23: No. 8, 269-270(Aug 1973).

The twin anode electrostatic ion source was modified to produce two separate ion beams of equal intensity. Ion beam densities of up to 1.5 mA/cm^2 were obtained for argon. The source can be used to ion etch two specimens at the same time under identical conditions of beam density, ion energy and pressure. (auth)

6053 ENERGY SPECTRA AND ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS EMITTED UNDER ION BOMBARDMENT. Mischler, J.; Benazeth, C.; Colombie, N.; Viel, L. (Univ., Toulouse). Vide; 28: No. 164, 63-64(Mar 1973). (In French).

In the energy spectrum of secondary electrons emitted under ionic bombardment from light elements (or compounds of these elements), a strong peak was observed at 2 eV and a fine structure was observed at higher energy. This structure is due to Auger transitions and characteristic losses. These transitions correspond to an inner-shell vacancy and either two valence-shell electrons or two atomic outer-shell electrons. The most intense Auger peak is attributed to an atomic Auger transition. The characteristic losses are ascribed to M shell ionization. The angular distributions of the secondary electrons from copper single crystals at a fixed energy show an anisotropy as a function of the azimuth angle at a given polar angle. These results are interpreted in terms of bulk electron diffraction followed by a refraction at the surface. (FR)

6054 ENERGY DISTRIBUTION OF SECONDARY IONS FROM 15 POLYCRYSTALLINE TARGETS. Jurela, Z. (Boris Kidric Inst., Belgrade). Radiat. Eff.; 19: No. 3, 175-180(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Fifteen metallic and semiconductor polycrystalline targets of 99.9% purity were bombarded with an Ar^+ ion beam of 40 keV energy. The energy distribution of different kinds of secondary ions of basic target material (atomic and molecular, positively and negatively charged), as well as of negative ions (C^-, C_2^-, O^- and O_2^-) formed by sputtering the surface impurities from bombarded targets was measured. The energy distribution of secondary ions was measured in the range of $E_i > 1$ eV. The upper measurement limit depended on the yield of observed ion species and it reached $E_i \leq 3000$ eV. The shape of the energy distribution curves could be explained satisfactorily by the law for the nonadiabatic emission process. (auth)

6055 ENERGY SPECTRUM OF ELECTRONS EMITTED BY ALKALI HALIDE CRYSTALS UNDER IMPACT OF ION AND ATOM BOMBARDMENT. Arifov, U. A.; Gaipov, S.; Rakhimov, R. R. (Inst. of Electronics, Tashkent). Radiat. Eff.; 19: No. 3, 151-154(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The energy distribution of electrons emitted by crystals of KBr, NaCl, and LiF under bombardment by Kr^+ and Kr^0, Ar^+ and Ar^0, He^+ and He^0 in the energy range of 100 to 6000 eV was studied by the method of analysis in the field of a 127^0 cylindrical condenser. The separation of electron and ion components from the general spectrum of secondary particles was carried out by a weak magnetic field directed at right angles to the electrical field of the condenser. A comparison of the electron spectrum

for ions and atoms illustrates the behavior of electron spectra of potential and kinetic emission. The energy spectra of electrons of kinetic electron emission are explained on the basis of the mechanism of the Auger phenomenon. (auth)

6056 ESTIMATION OF ION SCATTERING BY ATOMIC CHAINS ON SINGLE-CRYSTAL SURFACES. Marchenko, S. D.; Parilis, E. S.; Turaev, N. Y. (Inst. of Electronics, Tashkent). Radiat. Eff.; 19: No. 3, 147-149(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Estimation of ion movement close to atomic chains taking into account the elastic and inelastic energy losses and vacancy-type imperfections was performed on the basis of a model of binary interactions of ions with the atoms of a crystal. An analysis of results shows that scattering of ions by atomic chains is a phenomenon which makes a substantial contribution to scattering by the single-crystal surface. The inelastic energy losses exceed the single scattering losses by a factor of 5 to 6. (auth)

6057 ANOTHER EXPERIMENTAL EVIDENCE FOR COHERENT ELECTRONIC EXCITATION OF CHANNELED He^+ IONS. Gaillard, M. J.; Poizat, J. C.; Remillieux, J.; Gaillard, M. L. (Univ., Lyon). Phys. Lett.; 45A: No. 4, 306-308(8 Oct 1973).

The coherent excitation of He^+ ions passing along the [110] axis of a thin gold crystal was studied. Excitation occurs for several resonant energies, from 250 to 350 keV, which could be related to the Fourier frequency spectrum of the Coulomb perturbation. (auth)

6058 NEUTRAL-BEAM SPUTTERING OF POSITIVE ION CLUSTERS FROM ALKALI HALIDES. Richards, J.; Kelly, J. C. (New South Wales Univ., Kensington, Australia). Radiat. Eff.; 19: No. 3, 185-188(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Neutral argon atom beams of 15 keV energy were used to sputter alkali metal halides and the ejected positive ions were analyzed in energy, mass, and angular distribution. The use of a neutral beam rather than an ion beam minimizes surface charge and the deflection of ejected ions by electrostatic interaction with a charged incident beam. A cluster component of the form K_2Cl^+, $K_3Cl_2^+$, and higher members of the series is found for all alkali metal halides studied. (auth)

Atomic and Molecular Properties

Refer also to abstracts 5583, 6090, 6104, 6175, 6203, and 6513.

6059 (CNRS-CPT-73-P-542) PROJECTIVE GEOMETRY AND DYNAMICAL GROUPS. Bacry, H. (Aix-Marseille-1 Univ., 13 - Marseille (France)). 1973. 15p. (CONF-730660-1). Dep. NTIS (U. S. Sales Only) $3.00.

From second international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (Jun 1973).

Simple geometrical arguments lead to a description of the relationship between some symplectic manifolds of motions and ray spaces. An application concerning the quantization of the 3 - dimensional harmonic oscillator and the hydrogen atom is presented. (auth)

6060 (COO-3272-74) SPECTRA OF RARE EARTH IONS AND HYDROGEN MOLECULES. Final Report. Crosswhite, H. M. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1972. Contract AT(11-1)-3272. 15p. Dep. NTIS $3.00.

Research on the spectra of molecular hydrogen and its isotopes, rare earth crystal spectra, theoretical spectroscopy, and rare earth and uranium free ion spectra is summarized. A list of publications is included. (JFP)

6061 ALIGNMENT OF SOME TRIPLET AND SINGLET D STATES OF HELIUM. Yellin, J.; Hadeishi, T.; Michel, M. C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett.; 30: No. 26, 1286-1288 (25 June 1973).

The alignment of some singlet and triplet D states of ^4He resulting from the beam–foil interaction process at 40 kV has been measured for principal quantum numbers n=3, 4, 5, and 6. The measurements were based on zero-field level crossing. (auth)

6062 X-RAY PHOTOEMISSION STUDY OF SOME LIGHT RARE-EARTH METALS. Baer, Y.; Busch, G. (Laboratorium für Festkörperphysik, Eidgenössische Technische Hochschule, Hönggerberg, Ch-8049 Zürich, Switzerland). Phys. Rev. Lett. 31: No. 1, 35-37 (2 July 1973).

We present an x-ray photoemission spectroscopy study of the rare earths La, Ce, Pr, and Nd. We show that the spectra of these metals in the vicinity of the Fermi energy account for the 4f levels as well as for the valence states. The energy location of the 4f electrons is in fairly good agreement with an existing computation performed in the framework of the renormalized-atom method. (auth)

6063 AVOIDED INTERSECTION OF POTENTIAL ENERGY SURFACES: THE ($H^+ + H_2$, $H + H_2^+$) SYSTEM. Bauschlicher, C.W. Jr.; O'Neil, S.V.; Preston, R.K.; Schaefer, H.F. III (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Bender, C.F. J. Chem. Phys. 59: No. 3, 1286-1292 (1 Aug 1973).

Nonempirical electronic structure calculations have been carried out on the two lowest $^1A_1$ states of H_3^+. When one proton is infinitely separated from the other two, these $^1A_1$ potential surfaces cross each other. The nature of this avoided intersection is examined by means of potential curves, contour diagrams, and perspective plots. Surface hopping is discussed within a Landau–Zener–Stuckelberg (LZS) framework, and the LZS assumptions concerning the surfaces are shown to be reasonable near the avoided intersection. Ab initio LZS parameters are compared with those obtained from the semiempirical diatomics-in-molecules surfaces of Preston and Tully. The agreement is good, better than might have been anticipated. (auth)

6064 DYNAMIC MULTIPOLE POLARIZABILITIES OF TWO- AND FOUR-ELECTRON ATOMIC SYSTEMS. Arrighini, G.P. (Istituto di Chimica Fisica dell'Università di Pisa, Via Risorgimento 35, 56100 Pisa, Italy); Biondi, F.; Guidotti, C. Phys. Rev. A 8: No. 2, 577-588 (Aug 1973).

Dynamic multipole polarizabilities of a number of simple atomic closed-shell systems in their ground states have been calculated within the coupled time-dependent Hartree–Fock scheme. The systems here investigated include He, Li^+, Be^{2+}, B^{3+}, C^{4+}, Be, B^+, and C^{2+}. In order to acquire some feeling about the obtained results, the dipole polarizabilities have been evaluated either by using a scalar- or a vector-potential representation for the oscillating external field: these two choices give rise to the well-known polarizability expressions in terms of "length" and "velocity" oscillator strengths, respectively. Furthermore, a unitary transformation of the Hartree–Fock Hamiltonian is devised, which allows one to use a perturbation operator corresponding to that involved in the "acceleration" oscillator-strength expression. Estimates of transition energies to low-lying excited states have been also obtained from the frequency values at which the various polarizabilities display discontinuities. (auth)

6065 RECOIL CORRECTIONS TO THE HYDROGEN HYPERFINE INTERVAL AND BOUNDS ON THE PROTON POLARIZABILITY. Cole, R.S.; Repko, W.W. (Department of Physics, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. A 8: No. 2, 710-716 (Aug 1973).

We present the details of our calculation of the $(m_e/m_p)\,\alpha^2 Ry\alpha^{-1}$ corrections to the hyperfine splitting (ν_H) of the hydrogen ground state. The result $\Delta\nu_H = (8/3)(m_e/m_p)^2(1+m_e/m_p)^{-3} \times c\alpha^4 R_\infty\, hc\alpha^{-1}[9+7\kappa(1+\kappa) - (m_e/m_p)\,\kappa\,(3+14\kappa)] = 0.0016$ MHz (1.1 ppm), is combined with the corresponding formula for the muonium hyperfine interval to obtain an estimate of the proton polarizability δ_p. This estimate of δ_p is compared with those obtained by several other methods and all seem to be in reasonable agreement. (auth)

6066 ELEMENT HYDROGEN, ORTHO- AND PARA-HYDROGEN, ATOMIC HYDROGEN. Mackay, K. M. (Univ. of Waikato, Hamilton, N. Z.). pp 1-22 of Comprehensive Inorganic Chemistry. Volume 1. Trotman-Dickenson, A. F. (ed.). Oxford; Pergamon Press Ltd. (1973).

The properties of elemental hydrogen are detailed, together with those of its various forms. Topics discussed include preparation and production, physical properties, chemical properties, and atomic and nuclear properties. (84 references) (DHM)

6067 ELECTRONIC ENERGY LEVEL AND INTENSITY CORRELATIONS IN THE SPECTRA OF THE TRIVALENT ACTINIDE AQUO IONS. I. Es^{3+}. Carnall, W.T.; Cohen, D.; Fields, P.R.; Sjoblom, R.K.; Barnes, R.F. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 59: No. 4, 1785-1789 (15 Aug 1973).

The solution absorption spectrum of Es^{3+} has been measured in the region 10000-34000 cm^{-1}. The observed band structure has been interpreted in terms of free-ion energy levels calculated using parameters that are consistent with those obtained in analyses of the specta of earlier members of the $5f^N$-series. The correlation between observed and computed band intensities has also been examined and shown to be consistent with the energy level scheme adopted. (auth)

6068 VAN VLECK PERTURBATION TREATMENT OF SHORT-RANGE ATOMIC INTERACTIONS IN H_2^+ AND HeH^{++}. Chang, S. (Department of Chemistry, The John Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 59: No. 4, 1790-1795 (15 Aug 1973).

A modified version of Van Vleck perturbation theory, the distinguishable electron method, is applied to short-range diatomic

interactions in H_2^+ and HeH^{++}. Starting with united-atom wavefunctions φ_{0a} and φ_{0b} at two centers, a and b, as two degenerate states, each wavefunction is corrected to first order in charge-shifting perturbations, $Z_b(1/r_a - 1/r_b)$ and $Z_a(1/r_b - 1/r_a)$, where Z_i is the nuclear charge and r_i is the electron-nucleus distance. The final molecular wavefunction, correct to first order in charge-shifting perturbation, is then obtained by solving a secular equation; this is facilitated by making use of molecular symmetry and electron-nucleus cusp conditions. For a one-electron diatomic molecule the wavefunction Ψ to first order in charge-shifting perturbation, is shown to have the form $\Psi = (Z_a/Z)\,[\varphi_{0a} + \lambda Z_b f(\xi, \eta, Z, R)] + (Z_b/Z)[\varphi_{0b} + \lambda Z_a f(\xi, -\eta, Z, R)]$, where Z is the sum of nuclear charges, λ is the ordering parameter, and f is a function of Z,R, and confocal elliptic coordinates defined by $\xi = (r_a + r_b)/R$ and $\eta = (r_a - r_b)/R$. Application of the method to the ground states of H_2^+ and HeH^{++} gives better convergence than do the one-center calculations. The total energies evaluated to second order compare favorably with exact values for $R < 1.0$ a.u. in the case of H_2^+ and for $R < 0.75$ a.u. in the case of HeH^{++}. The physical interpretation of the charge-shifting processes is discussed and the method is compared with that of Byers-Brown and Power. (auth)

6069 IONIZATION ENERGIES OF DOUBLY AND TRIPLY IONIZED RARE EARTHS. Sugar, J.; Reader, J. (National Bureau of Standards, Washington, D.C. 20234). J. Chem. Phys. 59: No. 4, 2083-2089 (15 Aug 1973).

Values for the ionization energies of the doubly and triply ionized rare earth atoms have been derived from interpolated spectroscopic properties of the $4f^N ns$ series, and from interpolated energy intervals relating the first series member, $4f^N 6s$, to the ground state. The results in eV are —.

La III	19.1774(6)		Tb III	21.91(10)	IV 39.79(20)
Ce	20.198(3)	IV 36.758(5)	Dy	22.79(30)	41.47(20)
Pr	21.624(3)	38.98(2)	Ho	22.84(10)	42.48(32)
Nd	22.14(30)	40.41(20)	Er	22.74(10)	42.65(21)
Pm	22.32(36)	41.09(32)	Tm	23.68(10)	42.69(20)
Sm	23.43(30)	41.37(38)	Yb	25.03(2)	43.74(20)
Eu	24.70(32)	42.65(32)	Lu	20.9596(10)	45.19(2)
Gd	20.63(10)	44.01(35)	Hf		33.33(2)

The values for the doubly ionized atoms agree to within ≈ 1% with those deduced from thermodynamic measurements on lanthanide oxides. A value for the ionization energy of Gd II of 12.09(8) eV was determined by using new spectroscopic data for Gd II and Gd III. (auth)

6070 USE OF THE RAYLEIGH–RITZ–GALERKIN METHOD WITH CUBIC SPLINES FOR CONSTRUCTING SINGLE-PARTICLE BOUND STATE RADIAL WAVEFUNCTIONS. The Hydrogen Atom and Its Spectrum. Shore, B. W. (Univ. of California, Livermore). J. Phys., B (London); 6: No. 10, 1923-1932(Oct 1973).

A simple scheme of basis functions, piecewise-continuous cubic polynomials, together with a simple quadrature approximation for matrix elements are presented. Applied to the hydrogen atom, the method allows a dozen basis functions to approximate the 14 bound states 1s...5f with an average error of 0.03% in energies and 0.2% in the oscillator strengths of the 28 allowed transitions. (auth)

6071 PRESSURE DEPENDENCE OF HELIUM LINE INTENSITIES EXCITED BY FISSION FRAGMENTS. Paternoster, R. R. (Univ. of Florida, Gainesville); Walters, R. A.; Schneider, R. T. Trans. Amer. Nucl. Soc.; 17: 2-3(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6072 POPULATION INVERSIONS IN FISSION FRAGMENT EXCITED HELIUM. Shipman, G. R. (Univ. of Florida, Gainesville); Walters, R. A.; Schneider, R. T. Trans. Amer. Nucl. Soc.; 17: 3-4(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 6516, 6565, and 6595.

6073 (CONF-730807-7) POSITRONIUM REACTIONS WITH DIAMAGNETIC ORGANIC MOLECULES. Madia, W. J.; Nichols, A. L.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1973. 13p. Dep. NTIS $3.00.

From 166th American Chemical Society national meeting; Chicago, Illinois, USA (26 Aug 1973).

Rate constants for the interaction of ortho-positronium atoms with a series of diamagnetic organic compounds were determined. Nitrated aromatic molecules interact far more readily with ortho-positronium than do nitrated aliphatic molecules. The observed rate constants for the aromatic molecules show a distinct dependency on the nature of the subsituents and their relative positions in the aromatic ring. This dependency may be attributed to steric interactions which influence the relative electron charge density on the atoms in the molecule and alter the molecular energy levels. (auth)

6074 (INP-829) POSITRONIUM PHOTOPRODUCTION IN THE COULOMB FIELD: BOUND STATES IN THE INFINITE-MOMENTUM FRAME AND MULTI-PHOTON EXCHANGE. Jaroszewicz, T. (Institute of Nuclear Physics, Krakow (Poland)). Jun 1973. 85p. Dep. NTIS (U. S. Sales Only) $6.25.

The process of positronium photoproduction in the strong Coulomb field at high energy is investigated in the framework of the Cheng and Wu picture. A formalism to describe bound states in the infinite-momentum frame is developed. In the one-photon exchange approximation the results reduce to those obtained by means of the Weizsäcker-Williams method using the positronium decay width. From the calculation of multi-photon exchange corrections a rather unexpected conclusion was drawn: the quantity $\alpha Z/(q^2)1 \pm 12Z$, which is usually treated as the Coulomb amplitude, must be interpreted as the S-matrix element; otherwise serious contradictions arise in the case of para-positronium production. Similar remarks hold true for the pair production process. (auth)

6075 POSITRON STUDIES OF CONDENSED MATTER. West, R. N. (East Anglia Univ., Eng.). Advan. Phys.; 22: No. 3, 263-383(May 1973).

This review is concerned with the utilization of the positron–electron annihilation phenomenon in studies of the physics of condensed matter. The theory of the annihilation process is outlined, the importance of the two-photon mode of decay is established, and it is described how the observable results depend on the initial positron and electron states of the system. A brief account of the principal experimental techniques is included. Discussion of the complex nature of positron behavior in molecular substances suggests the particular value of investigations directed at the two photon pick-off mode of decay of the orthopositronium atoms that are formed in these materials. The possibility of positronium formation in ionic and metallic materials is also considered. The many important electron aspects of positron annihilation in metals are dealt with. The independent particle approach to the analysis of two photon angular distributions is discussed and illustrated. A survey of electronic structure investigations includes studies of polycrystalline and single crystal specimens. The relevance of angular correlation measurements in investigations of the Fermi surfaces of metals and alloys is discussed. More recently developed applications to the study of defected and disordered systems are dealt with. A preliminary account of the interpretation of multicomponent lifetime spectra in terms of varying numbers of distinguishable positron states provides the basis for a discussion of studies of positron trapping by defects, voids, and surfaces in ionic and metallic solids, liquids and powders. (auth)

6076 HIGHER-ORDER RELATIVISTIC CONTRIBUTIONS TO THE COMBINED ZEEMAN AND MOTIONAL STARK EFFECTS IN POSITRONIUM. Lewis, M.L.; Hughes, V.W. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 8: No. 2, 625-639 (Aug 1973).

A calculation of higher-order relativistic contributions to the combined Zeeman and motional Stark effects in positronium is presented. These contributions are necessary for the determination of the fine-structure interval in the ground state from the Zeeman effect and may be important in future experiments on the first excited states of positronium. The contributions to the g_J factors have been calculated to order α^2 for all the S states and for the 2P states. The energy levels and the higher-order corrections to the motional Stark effect in the first excited state are also presented. Relativistic contributions are obtained from the matrix elements of a Hamiltonian containing the Breit interaction, a Pauli Hamiltonian, and the virtual annihilation interaction. For all nS states the relativistic contributions to the Zeeman effect may be accounted for by the replacement of g_s by $g_s(1 - 5\alpha^2/24n^2 - T/2mc^2)$, where T is the kinetic energy of the atom and g_s is the gyromagnetic ratio of the free electron. (auth)

6077 THEORY OF INTERACTION BETWEEN ATOMS (MUONIUM, POSITRONIUM) AND MAGNETIZED SUBSTANCES. Baryshevskii, V. G.; Ivashin, A. V. (Belorussian State Univ., Minsk). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1467-1472(Oct 1973). (In Russian).

The interaction between atoms (muonium, positronium) and magnetized substances is considered. It is shown that the effective field produced in such substances as a result of exchange scattering evokes in positronium a linear Zeeman effect for the $m = \pm 1$ levels. Equations are derived which describe the time evolution of the polarization characteristics of muonium. It is shown that the effective exchange field appreciably alters the precession frequency of μ^+ mesons. (auth)

6078 SPONTANEOUS POSITRON PRODUCTION BY THE COULOMB FIELD OF A HEAVY NUCLEUS. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 29-31(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 53-58(5 Jul 1973).

The spontaneous production of positrons in a Coulomb field with $Z > Z_c$ (where $Z_c = 170$ is the critical charge of the nucleus) is of interest as an example of e^+e^- pair production via an unusual static mechanism. The calculation of the cross section in the entire range of energies and the energy spectrum of the produced positrons is needed for an experiment on the spontaneous production of e^+ in nuclear collisions, which is being planned for the near future. The results of such a calculation are presented for the differential and total cross sections. (JFP)

6079 TWO-MUON ATOMS. Fricke, B. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft on atomic and molecular physics; Munich, Germany (2 Apr 1973).

The experimental observation of x-ray transitions in two-muon atoms, which may soon be possible, is of great theoretical interest. Besides the Coulomb interaction of the muons which is taken into account in a relativistic self-consistent Hartree–Fock calculation, there are contributions in addition to those in one-muon atoms. The most important of these are the magnetic and the retardation interactions, as well as the vacuum polarization of the muon–muon interaction. Furthermore, some of these effects are coupled by a self-consistent calculation. Finally there is also a configuration interaction and a configuration-dependent effect of the moving nucleus. (GE)

6080 CONTINUOUS ANALOG OF NEWTON'S METHOD AS APPLIED TO THE CALCULATION OF THE BINDING ENERGY OF MESIC MOLECULES. Ponomarev, L. I.; Puzynin, I. V.; Puzynina, T. P. (Joint Inst. for Nuclear Research, Dubna, USSR). J. Comput. Phys.; 13: No. 1, 1-14(Sep 1973).

On the basis of the continuous analog of Newton's method, a method of numerical solving of Sturm–Liouville's problem is suggested, which has some advantages compared with the hitherto known ones. This method is used for calculating the binding energies of all vibrational states of the mesic molecules $pp\mu$, $dd\mu$ and $tt\mu$. In particular, one has first succeeded in calculating the binding energy of the highly excited level with $L = 1$, $\nu = 1$ of the mesic molecule $dd\mu$ which is important for interpreting experimental data. (auth)

Collision Phenomena

Refer also to abstracts 5894, 6071, 6613, and 6783.

6081 OBSERVATION OF Z=70 QUASIATOMIC K X RAYS FROM 30- AND 60-MeV $_{35}Br+_{35}Br$ COLLISIONS. Meyerhof, W.E.; Saylor, T.K.; Lazarus, S.M.; Little, W.A.; Triplett, B.B. (Department of Physics, Stanford University, Stanford, California 94305); Chase, L.F. Jr. Phys. Rev. Lett. 30: No. 26, 1279-1282 (25 June 1973).

A K-x-ray band up to the united-atom limit for Z=70 has been observed in 30- and 60-MeV Br+Br collisions. This band can be assigned unambiguously to transitions between molecular orbitals. With a KBr target, yields at the two energies are (for $E_x \geq 22$ keV) 2×10^{-4} and 10^{-7} photons/projectile, respectively, or 10^{-4} photons/beam K vacancy, nearly independent of beam energy. Much reduced yields are found for Ti, Fe, and Zr targets. (auth)

6082 K-VACANCY CREATION BY HIGH-Z HEAVY-ION IMPACT. Halpern, A.M.; Law, J. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. Lett. 31: No. 1, 4-6 (2 July 1973).

A competing process to direct K-shell ionization by heavy-ion impact is suggested to account for some recent data by Macdonald et al. It is found that the high-Z dependence of the x-ray yields can be accounted for by inclusion of K charge exchange into bound states of the fully stripped projectiles. (auth)

6083 FLUORESCENCE YIELD OF CARBON. Langenberg, A.; van Eck, J. (Fysisch Laboratorium van de Rijksuniversiteit, Utrecht, Nederland). Phys. Rev. Lett. 31: No. 2, 71-73 (9 July 1973).

Absolute cross sections for carbon K-shell x-ray production are measured and compared for the case of 0.1–1-MeV protons incident on thin solid targets (carbon foils) and a gaseous target (methane). These x-ray results combined with Auger measurements provide a fluorescence yield ω_K which is independent of the proton energy. (auth)

6084 EXPONENTIAL PROJECTILE CHARGE DEPENDENCE OF Ar K AND Ne K X-RAY PRODUCTION BY FAST, HIGHLY IONIZED ARGON BEAMS IN THIN NEON TARGETS. Mowat, J.R.; Sellin, I.A.; Pegg, D.J.; Peterson, R.S. (University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. Lett. 30: No. 26, 1289-1292 (25 June 1973).

Yields of projectile and target K x rays from collisons between ≈80-MeV argon ions and thin neon targets increase dramatically as the projectile charge is increased from +6 to +17. Although incrementing the projectile charge state amounts to "tuning" projectile L-shell energy through target K-shell energy, the 60-fold (≈exponential) increase in target yield and the more than 1000-fold (> exponential) increase in projectile yield can be partially understood as the effect of a rapidly changing fluorescence yield, but not as an energy-level-matching effect. (auth)

6085 ELECTRICAL CURRENT IN ELECTRON-BEAM IONIZED N_2 AND CO_2. Basov, N.G.; Belenov, E.M.; Danilychev, V.A.; Kerimov, O.M.; Kovsh, I.B.; Suchkov, A.F. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 17: No. 12, 1976-1981 (June 1973).

The conductivity of a compressed gas (N_2, CO_2, and mixtures of these gases) ionized by an intense electron beam is investigated experimentally and theoretically. It is shown that the effect of spatial separation of charge is insignificant and that the electrical current passing through a highly ionized gas between metal electrodes is determined by the mobility of the electron components. A theoretical analysis of the observed phenomenon is provided. It is shown experimentally that it is possible to obtain high current densities (≈1000 A/cm²) in compressed ionized gases in an electric field that is smaller than the ignition field. (auth)

6086 DETERMINATION OF ION DENSITY IN AN ELECTRON BEAM IN A GAS. Bogdanova, I.P.; Marusin, V.D.; Yakhontova, V.E. (A. A. Zhdanov Leningrad State University). Sov. Phys.-Tech. Phys. 17: No. 12, 1952-1957 (June 1973).

Equations are derived which make it possible to determine the average density of ions and slow electrons in an electron beam in a gas; the time to reach equilibrium density and the relaxation time following excitation are also obtained. The case is considered in which the gas pressure is 0.001–0.1 torr and the current density is less than 0.01 A/cm². Recombination is small under these conditions, and the charged-particle balance is determined by the production rate due to electron-impact ionization and the rate at which charge particles are lost to the electrodes. The equations are applied in the analysis of an experiment in which the intensity of the mercury line Hg II λ 6150 Å is measured as excited by an electron beam in a mixture of mercury and helium. (auth)

6087 FREDHOLM UNIFORMIZATION COMPUTATION OF ELASTIC SCATTERING AMPLITUDES IN THE PRESENCE OF ARBITRARILY MANY OPEN CHANNELS. Reinhardt, W.P. (Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. A 8: No. 2, 754-762 (Aug 1973).

A uniformization technique is used to compute elastic scattering amplitudes at energies where arbitrarily many channels are open. The method takes knowledge of the Fredholm determinant D(z), on the physical sheet and uses rational-fraction analytic continuation to continue D(z) onto the appropriate Riemann sheet to construct the elastic amplitude and total inelasticity. Numerical examples for two-, three-, and four-channel problems are given, and preliminary results which indicate that the method may be of use in the breakup region are presented. (auth)

6088 MEASUREMENT AND CALCULATION OF THE STARK-BROADENING PARAMETERS FOR THE RESONANCE LINES OF SINGLY IONIZED BERYLLIUM. Sanchez, A.; Blaha, M.; Jones, W.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. A 8: No. 2, 774-780 (Aug 1973).

The electron-impact-broadened profile of the resonance doublet of singly ionized beryllium (2s-2p, λ = 3130.4 and 3131.1 Å) has been measured using an electromagnetically driven shock tube and a rapid-scanning Fabry-Perot spectrometer. For the conditions $N_e = 10^{17}$ cm^{-3} and T = 19 000 °K, we found the Lorentz half-width of each line in the doublet to be 0.035 Å ± 15%. For comparison with theory, we did both a quantum-mechanical (using the close-coupling method) and a semiclassical calculation, obtaining the values 0.015 and 0.042 Å, respectively. Possible reasons for the discrepancy are discussed. (auth)

6089 OPTICAL-PUMPING CHARGE-EXCHANGE METHOD FOR STUDYING NUCLEAR-SPIN ORIENTATION IN $^1S_0$ ATOMIC

IONS. Mitchell, J.K.; Fortson, E.N. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. A 8: No. 2, 704-709 (Aug 1973).

A detailed description is presented of an optical–pumping charge–exchange method for establishing and observing nuclear–spin orientation in atomic ions having a $^1S_0$ electronic configuration. Rb^+, Cs^+, K^+, and free protons have been studied thus far. Various applications of the method include precision measurements of the nuclear moments in the ions and the first measurements of resonant charge–exchange cross sections at thermal energies. (auth)

6090 POLARIZABILITY OF INTERACTING ATOMS: RELATION TO COLLISION–INDUCED LIGHT SCATTERING AND DIELECTRIC MODELS. O'Brien, E.F.; Gutschick, V.P.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109); McTague, J.P. Phys. Rev. A 8: No. 2, 690-696 (Aug 1973).

The polarizability tensor of a pair of interacting He atoms has been calculated as a function of internuclear separation r using the fully self–consistent Hartree–Fock theory. It was found that the trace of the polarizability tensor, α (r), to which the second dielectric virial coefficient B_ϵ is directly proportional, decreases with decreasing r, giving a theoretical value of $B_\epsilon = -0.093$ a.u. at room temperature, compared with the experimental result $B_\epsilon = -0.06 \pm 0.04$ a.u., measured by Orcutt and Cole [J. Chem. Phys. 46, 697 (1967)]. This is the first calculation that predicts the correct sign of B_ϵ. We conclude that for He the effects of overlap are of opposite sign from and of sufficient magnitude to overcome the contributions of the van der Waals interaction to α (r). Furthermore, the anisotropy of the pair polarizability β (r) can be represented by a simple form: $\beta(r) = 6\alpha^2 r^3 - \lambda e^{-r/r_0}$, where $r_0 = 0.74$ a.u., and the collision–induced light–scattering spectrum predicted by this form has an essentially exponential line shape. These results are in qualitative agreement with recent work on collision–induced light–scattering spectra from rare gases. (auth)

6091 EXCITATION AND ELECTRON CAPTURE IN COLLISIONS OF Li^+ WITH Li. Chang, C.; Rapp, D. (The University of Texas at Dallas, Dallas, Texas 75230). J. Chem. Phys. 59: No. 3, 1266-1275 (1 Aug 1973).

Coupled–state calculations have been performed for the collision processes $Li^+ + Li(2s) \rightarrow Li^+ + Li(nl) \rightarrow Li(nl) + Li^+$, in which 1, 3, 4, or 6 of the states 2s, $2p_0$, $2p_1$, 3s, $3p_0$, $3p_1$ were included on each nuclear center as traveling–wave atomic orbitals. The rectilinear path impact parameter method was used, and cross sections for populating the various channels were determined over the energy range 0.4–400 keV. The atomic wavefunctions were obtained by solving the time–independent Schrödinger equation for a single valence electron in the field of the nucleus plus an exponential inner charge cloud. This pseudopotential was carried over into the dynamical calculation as the potential holding the single electron to the effective Li^+ center. Therefore, our atomic wavefunctions are essentially exact solutions of the asymptotic Hamiltonian at large nuclear separations. The same numerical methods used previously for (H^+, H) and (He^{++}, H) collisions were used here. The inclusion of the 2p states had a strong effect on the calculated cross section for total electron capture, but higher states did not. When the 2p states are included, we find that the large oscillations in the curve of total capture cross sections vs energy are almost completely damped out. This is in disagreement with experiment, where oscillations are observed. However, the oscillations derive mostly from small impact parameters, where our method is least reliable. The over–all magnitude and energy dependence are in good agreement with experiment. Our calculations also predict a very large cross section [$\sim$ 60 Å^2 at 100 keV] for direct excitation of Li by Li^+ at high collision energies. No data are available for comparison at present. (auth)

6092 ELECTRON CAPTURE AND EXCITATION IN ALKALI ION–ATOM COLLISIONS USING AN ATOMIC EIGENFUNCTION EXPANSION. Rapp, D.; Chang, C. (The University of Texas at Dallas, Dallas, Texas 75230). J. Chem. Phys. 59: No. 3, 1276-1282 (1 Aug 1973).

Previous calculations of (Li^+, Li) scattering utilizing an expansion in traveling atomic orbitals have been extended to the collisions (Na^+, Na), (Li^+, Na), and (Na^+, Li). While the over–all trends of the experimental energy dependences of the cross sections are reproduced by the theory, the detailed structure in the data is very poorly represented by our calculations. Since this structure is due to collisions at small impact parameter (less than $\sim 5\ a_0$) it appears that a variational technique is required to allow the atomic orbitals to contract at small separations. Unless this is done, the atomic expansion method fails badly at small impact parameter. We believe the calculations are reasonable at large impact parameters, however. (auth)

6093 TESTS OF SHARMA'S THEORY OF NEAR RESONANT ENERGY EXCHANGE USING THE MOLECULES CO_2 AND COS. Simpson, C. J. S. M.; (Physical Chemistry Lab., Oxford); Gait, P. D.; Simmie, J. M. Chem. Phys. Lett.; 22: No. 1, 144-145 (15 Sep 1973).

Sharma's theory of near resonant energy exchange was tested by measuring the rates of vibrational energy excitation in the molecules CO_2 and COS using hydrogen and its isotopes and isomers as collision partners. The calculated rates agree well with experiment in the CO_2 systems, but fail for those using COS. (auth)

6094 POST–THRESHOLD BEHAVIOR FOR CO^+ COLLISION–INDUCED DISSOCIATION. Grossheim, T. R. (Univ. of Missouri, St. Louis); Leventhal, J. J.; Harris, H. H. Chem. Phys. Lett.; 22: No. 1, 137-139(15 Sep 1973).

The relative cross sections for the collision–induced dissociation of CO^+ on five rare gases were measured near threshold. The data are compared with the recent statistical theory of Rebick and Levine in the energy range 0 to 2 eV above threshold. In this energy range, no one form of the Rebick–Levine theory fits all of the data. Agreement with the theory improves as the mass of the target atom increases. (auth)

6095 NITROGEN ROTATIONAL EXCITATION BY COLLISIONS WITH ARGON: OBSERVATIONS AND COMPARISON WITH THEORY. Scott, P. B.; Mincer, T. R.; Muntz, E. P. (Univ. of Southern California, Los Angeles). Chem. Phys. Lett.; 22: No. 1, 71-74(15 Sep 1973).

Measurements of the distribution of rotational states in a nitrogen molecular beam before and after deflection by collision with rare gas atoms are interpreted in terms of the intermolecular potential. A potential of the form $V(R,\theta) = 4\epsilon[1 + b_2P_2(\cos\theta)/R^{*12} - 4\epsilon[1 + a_2P_2(\cos\theta)]/R^{*6}$ is used with semiclassical theory using the sudden approximation to fit the observations. As a_2 is known, as well as ϵ and the size parameter, σ, the objective is to find b_2. However, the calculated state distributions are found to systematically vary from those measured, irrespective of the value of b_2. This result is tentatively explained as due to the inadequacies of the 12–6 potential. (auth)

6096 EFFECT OF RESONANCES IN ELASTIC SCATTERING ON THE BREMSSTRAHLUNG OF ELECTRONS IN AN ATOMIC FIELD. D'yachkov, L. G.; Kobzev, G. A.; Norman, G. E. (Inst. of High Temperatures, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1399–1406(Oct 1973). (In Russian).

The role of resonances in elastic electron–atom scattering involving radiation emission and absorption by an electron is considered. An approach developed by Fano for describing the effect of autoionization on photoionization and photorecombination spectra is employed. It is shown that the resonance can approximately be described as an unstable negative ion; the cross sections for the corresponding processes of photodetachment and photoattachment may exceed by an order of magnitude or more the cross sections for bremsstrahlung processes in the visible and ultraviolet spectral ranges. (auth)

6097 PROBABILITIES FOR POPULATION OF ROTATIONAL LEVELS IN ELECTRON EXCITATION OF DIATOMIC MOLECULES. Rubin, P. L. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1375-1381(Oct 1973). (In Russian).

By employing the rotational group representations the cross sections for excitation of rotational levels are expressed in the adiabatic approximation in terms of j–symbols and quantities characterizing electron scattering by a molecule with a fixed nuclear position. Formulas are also presented for the case when the Born approximation is applicable and the cross section depends only on the difference of the momenta of the incident and scattered electrons. (auth)

6098 INTERATOMIC POTENTIALS. Torrens, I. M. New York; Academic Press (1972). 260p.

The topics discussed are the nature of interatomic forces, theoretical models of the atom, interatomic potentials based on Thomas–Fermi theory, empirical interatomic potentials, pseudopotential theory, pair potentials based on pseudopotential theory, atomic collision theory and interatomic potentials, experiments on the scattering of atoms and ions, liquid metal pair interaction potentials, the application of interatomic potentials. Also the Thomas–Fermi screening function, Hartree dielectric screening of the pseudopotential, the cohesion of ionic crystals, interatomic potentials derived from planar channeling data are covered. (UK)

6099 ELECTRONIC–TO–VIBRATIONAL ENERGY TRANSFER IN A COLLISION OF CO WITH $Hg(^3P_0)$. Fushiki, Y.; Tsuchiya, S. (Tokyo Univ.). Chem. Phys. Lett.; 22: No. 1, 47-51 (15 Sep 1973).

The energy transfer process, $Hg(^3P_0) + CO(0) \rightarrow Hg(^1S_0) + CO(\nu)$, was studied by the measurement of the IR fluorescence of CO, using modulated Hg–resonant radiation to excite Hg atoms. The cross section for each final vibrational level of $\nu + 2$ to 9 is 0.045, 0.091, 0.15, 0.17, 0.15, 0.065, 0.013, and 0.006 Å^2, respectively. (auth)

6100 DISSOCIATIVE IONIZATION OF O_2 AND N_2 BY ELECTRON IMPACT: N^+ AND O^+ KINETIC ENERGIES AND ANGULAR DISTRIBUTIONS. Stockdale, J. A. D.; Deleanu, L. (Oak Ridge National Lab., TN). Chem. Phys. Lett.; 22: No. 1, 204-208(15 Sep 1973).

An apparatus containing crossed molecular and pulsed electron beams was used to obtain distributions in kinetic energy and angle of fast (≥0.5 eV) positive ions produced through dissociative ionization of N_2 and O_2 by impact of 50 to 200 eV electrons. Four main O^+ ion groups are observed with peak energies of 0.8, 2.0, 3.0, and 5.0 eV. Two main N^+ groups peaking at 2.0 and 3.0 eV are seen. Angular distributions of both N^+ and O^+ ions are essentially isotropic for electron-beam–ion detection angles from 30 to 110°. (auth)

6101 INELASTIC NONVIOLENT HEAVY-ATOM COLLISIONS. Bierman, D. J.; Turkenburg, W. C. (Inst. for Atomic and Molecular Physics, Amsterdam). Physica; 67: No. 3, 533-563(1 Aug 1973).

Measurements are presented of inelastic energies dissipated during small-angle scattering of Ar^+ ions by Ar and Ne^+ by Ne. The primary energies range from 3.5 to 90 keV. In the secondary-energy spectrum of the projectiles typical structures are observed which are contributed to different possible excitation channels. An elastic peak and a peak due to excitation of the target atom are observed. Other peaks and details of the structure cannot be interpreted in an unique way. It may partly be explained by simultaneous excitation of projectile and target particle although excitation of projectile alone is not observed. However, for the inelastic energy spectra arising from Ne^+–Ne collisions in which the product of primary energy and scattering angle is larger than 10 keV deg no satisfactory explanation can be given in terms of well defined excitations. Relative differential cross sections for elastic scattering show oscillations. These oscillations are caused by interference of partial waves scattered by different potentials. Semiclassical calculations of elastic differential cross sections are presented. Instead of using the impact-parameter approximation, the "exact" orbits of the particles are calculated to obtain the phase shifts. Furthermore, using the same methods, the critical internuclear distance, at which the potentials cross which play a role in neon ($2p^5$,3s) excitation, is calculated as well as the inelastic differential cross section for the process $Ne^+ + Ne \rightarrow Ne^+ + Ne^*$ ($2p^5$,3s). (auth)

6102 MATRIX VARIATIONAL METHOD FOR ELECTRON–ATOM SCATTERING. Lyons, J. D. (IBM Research Lab., San Jose, CA); Nesbet, R. K.; Rankin, C. C.; Yates, A. C. J. Comput. Phys.; 13: No. 2, 229-259(Oct 1973).

Computational and data-handling algorithms are given for a matrix variational method designed for a broad class of problems in the quantum theory of electron-atom scattering. As implemented, the method is applicable to low energy elastic or inelastic electron scattering by a neutral atom of arbitrary shell structure. (auth)

6103 ELECTRON SCATTERING FROM DIATOMIC MOLECULES IN THE FIRST BORN APPROXIMATION. Liu, J.W. (Department of Chemistry, Indiana University, Bloomington, Indiana 47401). J. Chem. Phys. 59: No. 4, 1988-1998 (15 Aug 1973).

The differential cross sections for electron scattering from the diatomic molecules H_2 and N_2 in the first Born approximation, using molecular wavefunctions, have been calculated. The molecular wavefunctions for H_2 and N_2 were in the form of a Slater determinant(s) with one-electron Slater-type orbitals (STO's). For the purpose of simplifying the calculation the STO's involved in all two-center but not one-center integrals were expanded in Guassian-type orbitals (GTO's). The result of the calculation for H_2, using a configuration interaction (CI) wavefunction containing 97% of the binding energy, leads to agreement with existing experimental data. The calculated scattered intensity for H_2 can be considered as the most accurate one for comparison with experiment at the 1% accuracy level. This accurary is a result of the approximate wavefunction containing 1% less energy than the total experimental energy. For the case of N_2 the double ξ exponent wavefunction of Richardson was used. It was found that the scattered intensity of the electron–nuclear bonding charge density is very sensitive to the choice of molecular wavefunction used. This study represents the most definitive calculation of the two-electron effects in total scattered intensity so far reported. The total result, including both one- and two-electron terms, was found to be in qualitative agreement with experiment. (auth)

6104 EXCITATION OF THE 4 ^3S AND 3 ^3P LEVELS OF HELIUM BY ELECTRON IMPACT. Anderson, R.J.; Hughes, R.H.; Tung, J.H.; Chen, S.T. (Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. A 8: No. 2, 810-815 (Aug 1973).

The exchange excitation of the 4 ^3S and 3 ^3P levels of helium by electron impact has been studied by means of time-resolved spectroscopy of the 4 $^3S \rightarrow 2\ ^3P$ (λ = 4713-Å) and 3 $^3P \rightarrow 2\ ^3S$ (λ = 3889-Å) transitions. Measurements were carried out for incident electron energies in the range 50–400 eV at helium-gas pressures of 8 and 4 mtorr. Radiative cascade transitions from the n ^3P levels and from the n ^3S and n ^3D levels contributed 12 and 10% to the total 4 ^3S and 3 ^3P populations, respectively, at 50 eV. These fractions increased to about 30 and 40%, respectively, at 400-eV electron-impact energy. The 4 ^3S and 3 ^3P direct-excitation cross sections were observed to decrease with increasing electron impact according to the relation $(\text{energy})^{-3}$. This result is in agreement with the theoretical predictions of Ochkur and Bratsev. (auth)

6105 MOLECULAR COLLISIONS. XIX. THE DISTORTED WAVE APPROXIMATION TO ATOM–RIGID SYMMETRIC TOP ROTATIONAL EXCITATION. Russell, D.; Curtiss, C.F. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 59: No. 4, 1974-1983 (15 Aug 1973).

In Paper XVII of this series an exact formalism describing nonreactive collisions of vibration polyatomic molecules was developed. The present work specializes this formalism to the case of an atom–rigid symmetric top collision. A distorted wave approximation is developed which is appropriate for a symmetric top in which the moment of inertia about the symmetry axis is much smaller than that about the remaining principal axes. The solution obtained is then expressed in terms of the generalized phase shift formalism. (auth)

6106 MEASUREMENT OF ABSOLUTE TOTAL SCATTERING CROSS SECTIONS FOR NEON, ARGON, AND OXYGEN. Morrow, D.P.; Aldridge, J.P.; Skofronick, J.G. (Department of Physics, Florida State University, Tallahassee, Florida 32306). J. Chem. Phys. 59: No. 4, 2145-2147 (15 Aug 1973).

Absolute total cross sections for the Ne + Ne, Ar + Ar and $O_2 + O_2$ interactions have been measured in the thermal energy range using the crossed nozzle beam technique. Corrections to the cross section were made to account for the finite sizes of the detector and the beams. Scattering beam particle densities for each cross section were obtained using a capacitance manometer. (CES)

6107 ELECTRON–IMPACT IONIZATION OF ALKALI METALS. Roy, B.N.; Rai, D.K. (Department of Physics, Banaras Hindu University, Varanasi-5, India). Phys. Rev. A 8: No. 2, 849-855 (Aug 1973).

Classical binary-encounter calculations using a Hartree–Fock velocity distribution for the bound electrons have been carried out for electron–impact ionization of alkali metals. The effect of inner-shell ionization, as well as the excitation of some autoionizing levels, has been included. A satisfactory agreement with recent experimental observations has been achieved. (auth)

6108 TOTAL CROSS SECTIONS FOR INELASTIC SCATTERING OF CHARGED PARTICLES BY ATOMS AND MOLECULES. VII. THE NEON ATOM. Saxon, R.P. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 8: No. 2, 839-849 (Aug 1973).

The Bethe theory for the calculation of the total inelastic cross section σ_{tot} for the scattering of fast charged particles by atoms and molecules is applied to neon. As part of the analysis, the spectral distribution of the oscillator strength has been determined by critical evaluation of all experimental data and by test of several sum rules. The result is $\sigma_{tot} = z^2\beta^{-2}[3.524[\ln(\beta^2/(1-\beta^2)) - \beta^2] + 36.06] \times 10^{-20}$ cm^2 for a particle of charge ze and speed βc. As an application, the ionization cross section is estimated by subtracting the sum of all the discrete excitation cross sections from σ_{tot} and is compared with experimental values. (auth)

6109 $M_{2,3}$–REGION X-RAY EMISSION SPECTRUM FROM GASEOUS KRYPTON. LaVilla, R.E. (National Bureau of Standards, Washington, D. C. 20234). Phys. Rev. A 8: No. 2, 1143-1145 (Aug 1973).

The $M_{2,3}$ x-ray emission spectrum of gaseous krypton excited by direct electron bombardment has been recorded with a scanning single-flat crystal spectrometer. The most prominent spectral features are two peaks at 187 and 203 eV, with the 187-eV peak having an extended low-energy tail. This low-energy tail is attributed to double-electron single-vacancy transitions owing to the strong mixing of the final-state configuration $4s4p^6$ ^2S with the even levels $4s^24p^4ns$ ^2S $4s^24p^4nd$ ^2S The 203-eV peak is identified as probably the single-electron double-vacancy $M_{2,3}M_{2,3} \rightarrow M_{2,3}N_1$ multiplet complex. (auth)

6110 DETECTION OF NITROGEN ATOMS IN THE $2s(2p)^33s$ $^4S_{3/2}$ METASTABLE AUTOIONIZING STATE. Fairchild, C.E.; Garg, H.P. (Department of Physics, Oregon State University, Corvallis, Oregon 97331); Johnson, C.E. Phys. Rev. A 8: No. 2, 796-804 (Aug 1973).

Metastable nitrogen atoms, produced by electron–impact dissociation of N_2, have been detected in time-of-flight apparatuses located at Oregon State University and at University of California at Berkeley.

Two different types of metastable atoms are detected; one type resembles Rydberg hydrogen atoms, while the other does not. The measured natural lifetime for the non-Rydberg atoms is 100 ± 25 μ sec. Additional information regarding the identity of both types of metastable atoms is obtained by observing their quenching in a static electric field. The field-dependent decay constant for the Rydberg atoms is essentially a step function, and these atoms are entirely quenched by a field of 1.5 kV/cm. Both results are consistent with theory if the Rydberg atoms are in levels with principal quantum number greater than 25. The field-dependent decay constant for the non-Rydberg atoms varies quadratically with the strength of the applied electric field. In a field of 4 kV/cm applied along a 6-cm length of flight path, the value of this decay constant is 0.3×10^6 sec $^{-1}$. The quenching results, together with the lifetime measurement, are a strong indication that the non-Rydberg atoms detected in the time-of-flight spectra are nitrogen atoms in the $2s(2p)^3 3s\ ^4S_{3/2}$ metastable autoionizing state. (auth)

6111 TIME AND PRESSURE DEPENDENCE OF THE VACUUM-ULTRAVIOLET RADIATION IN NEON. Leichner, P.K. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. A 8: No. 2, 815-822 (Aug 1973).

A 250-keV electron accelerator was used to carry out time-dependent studies in neon gas at the wavelength of the $^1P_1$ and $^3P_1$ resonance line and the 850-Å continuum over a wide range of pressures, up to 1000 Torr. The resonance line decays exponentially with a lifetime that is governed predominantly by the escape of resonance radiation to the walls of the emission chamber and by three-body destruction of the resonance states. The main continuum near 859 Å comes to a maximum well after termination of the excitation pulse and then decays with a lifetime that is very long at low pressures. However, this lifetime decreases with increasing pressure at low and intermediate pressures and assumes a nearly constant value of 5.1 μsec at the highest pressures. From the time-dependent studies it is proposed that both $^1P_1$ and $^3P_1$ resonance states are converted to metastable molecular states by three-body collisions. The metastable molecules in turn may undergo two- and three-body collisions with ground-state atoms which convert them to radiative molecules that radiate the 850-Å continuum with a lifetime of about 5.1 μsec. (auth)

6112 FORMULATION OF THE BINARY-ENCOUNTER APPROXIMATION IN CONFIGURATION SPACE AND ITS APPLICATION TO IONIZATION BY LIGHT IONS. Hansen, J.S. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. A 8: No. 2, 822-839 (Aug 1973).

The binary-encounter approximation (BEA) is transformed from momentum space to configuration space. In this frame the impact-parameter representation allows one to calculate a variety of quantities pertinent to the general problem of ionization. Among these are cross sections for proton ionization of hydrogen and helium; in the latter case, cross sections for ejection of both electrons are also given. A number of tables and formulas are given, enabling one to correct the simple hydrogenlike-model predictions of the BEA for effects which arise in multielectron atoms. Multiple-ionization probabilities (K + L shell) are calculated and compared to experimental results and to the predictions of the semiclassical approximation. (auth)

6113 TEMPERATURE DEPENDENCE OF THE e-Na AND e-Rb SPIN-EXCHANGE CROSS SECTIONS. Davis, S.J.; Balling, L.C. (Department of Physics, University of New Hampshire, Durham, New Hampshire 03824). Phys. Rev. A 8: No. 2, 1136-1138 (Aug 1973).

The e-Rb and e-Na spin-exchange cross sections have been measured in a spin-exchange optical-pumping experiment as a function of temperature over the range 300-660 °K for Rb and 400-725 °K for Na. Within experimental error, the cross sections are essentially constant as a function of temperature. Measurements at 293 °K give $\sigma_{SE}(Rb) = (7.0 \pm 2.0) \times 10^{-14}$ cm^2 and measurements at 403 °K give $\sigma_{SE}(Na) = (3.2 \pm 1.0) \times 10^{-14}$ cm^2. (auth)

6114 ASSOCIATIVE AND NON-ASSOCIATIVE ION PAIR FORMATION BY FAST ATOMS. Wexler, S. (Argonne National Lab., IL). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 606-627 (1973).

Recent results on collision processes of accelerated atoms which lead to ion production are discussed. There are described: collision-induced dissociative ion pair formation, electron transfer, associative ionization, reactive ionization, and simple collisional ionization. The review is restricted to ion product reactions that have been studied in molecular beam experiments in which two neutral species collide with relative energies up to 20 eV, and the endoergicity of the reaction is provided by the kinetic energy of one of the partners. The accelerating techniques capable of producing beams of fast atoms and molecules are described. Characteristics of such reactions are the cross sections for the various reaction channels and their dependences on the relative energy, the behavior of the cross section near threshold, the relative importance of translational and internal energy in promoting the reaction, and the dynamics of the collisions as revealed by the angular distributions of the products. Results are presented. The polar dissociation of the thallium halides by accelerated Xe and Kr atoms, and the dynamics of a number of reactions of fast metal and non-metal atoms with several molecules are described in detail. (GE)

6115 NEGATIVE ION-MOLECULE REACTIONS OF LOW ENERGY AND ELECTRON EXCHANGE PROCESSES. Hauffe, B. J. (Univ., Hamburg). Z. Phys. Chem. (Frankfurt); 85: No. 1-4, 175-190(1973). (In German).

Ion-molecule reactions and charge-transfer processes have been investigated under single collision conditions from about 1 eV to 200 eV. The reaction systems (I $H^- + H_2O$, $D^- + D_2O$, $H^- + D_2O$, $D^- + H_2O$; (II) H^- (resp. D^-) + O_2, NO_2, SO_2; (III) $O^- + H_2$, D_2, O_2; (IV) H^- (resp. D^-) + D_2, ND_3, CH_3OD, C_2H_5OD (resp. H_2, NH_3, CH_3OH, C_2H_5OH, C_2H_2) were studied. For the formation of negatively charged secondary ions from several energetically possible reaction channels only one was always preferred. For the reaction systems of groups I and III, ion-molecule reactions were generally found, ($O^- + O_2$, in addition, a charge transfer process). For the reaction systems in group II, only charge-transfer processes have been detected, while reactions of group IV did not proceed by either process. (GE)

6116 DIFFERENTIAL CROSS SECTION FOR ELASTIC SCATTERING OF ELECTRONS BY H_2 IN THE FIRST BORN APPROXIMATION. Liu, J. W.; Smith, V. H. Jr. (Queen's Univ., Kingston, Ont.). J. Phys., B (London); 6: No. 10, L275-L279 (Oct 1973).

An accurate calculation of the elastic electron scattering intensity for $H_2(x^1\Sigma_g^+)$ in the first Born approximation using the Davidson-Jones wave function (J. chem. Phys.; 37: 2966 (1962)) is reported and compared with intensities based on simpler wave functions as well as recent experimental data. (auth)

6117 EXCITATION OF HELIUM CAUSED BY FISSION FRAGMENTS. Shipman, G. R. (Univ. of Florida, Gainesville); Walters, R. A. Trans. Amer. Nucl. Soc.; 17: 1(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6118 ELECTRON ENERGY DISTRIBUTION FUNCTION OF FISSION FRAGMENT EXCITED GASES. Walters, R. A. (Martin Marietta Corp., Denver); Schneider, R. T. Trans. Amer. Nucl. Soc.; 17: 1-2(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Atomic Theory

Refer also to abstracts 6196 and 6203.

6119 CLOSED-FORM HYDROGENIC RADIAL r^k MATRIX ELEMENTS AND THE FACTORIZATION METHOD. Badawi, M.; Bessis, N.; Bessis, G.; Hadinger, G. (Laboratoire de Spectroscopie et de Luminescence, Universite Claude Bernard, Lyon I, 69621 Villeurbanne, France). Phys. Rev. A 8: No. 2, 727-733 (Aug 1973).

It is shown that the factorization method, when introducing accelerated ladder operators or accelerated ladder matrices, leads to a formula in closed form for the general off-diagonal $(n + n')$ hydrogenic r^k matrix elements. This explicit expression, which involves only factorials and binomial coefficients, is directly reducible to any particular case. The well-known selection rules follow from the formula. The method seems appropriate to other cases of factorizable equations. Its extension to the Dirac–Coulomb and generalized Kepler problems and the discrete-continuous case is considered. (auth)

6120 GREEN'S FUNCTION TREATMENT OF A TWO-LEVEL ATOM: EFFECT OF A GROUND-STATE-ELECTROMAGNETIC-FIELD INTERACTION. Duncan, G. C. (Bowling Green State Univ., OH). Nuovo Cim., 18B: No. 1, 41-52(11 Nov 1973).

The Heisenberg Green's function approach is applied to a two-level atom interacting with a quantized radiation field. A model Hamiltonian that includes a ground-state–electromagnetic-field interaction in addition to the rotating-wave approximation (RWA) model is employed. It is shown that the effects of the ground-state interaction may be exactly computed for the cases of excited-state decay and the scattering of a photon by a ground-state atom. A comparison is made between the results for the present model and those that are obtained using the RWA model. The application of the Green's function techniques to more complicated interactions is discussed relative to the results based on the present modification of the RWA model. (auth)

6121 COMMENT ON "LENGTH AND VELOCITY FORMULAS IN APPROXIMATE OSCILLATOR-STRENGTH CALCULATIONS". Starace, A. F. (Department of Physics, Imperial College, London, S. W. 7, England). Phys. Rev. A 8: No. 2, 1141-1142(Aug 1973).

A previous paper by Starace showed that the length formula for the electric dipole matrix element is the only consistent one for calculations that solve for the exact eigenfunctions of an approximate Hamiltonian containing a nonlocal potential. It is emphasized here that disagreement between such a length-formula calculation and experiment indicates inadequacy of the approximate Hamiltonian and not that the velocity formula may be preferable. (auth)

6122 BRILLOUIN'S THEOREM FOR EXCITED (nl)q(n'l)q' CONFIGURATIONS. Fischer, C. F. (Univ. of Waterloo, Ont.). J. Phys., B (London); 6: No. 10, 1933-1941(Oct 1973).

It is shown that in the nonorthogonal Hartree-Fock approximation Brillouin's theorem holds for all functions $\tilde{\Phi}_c$. obtained from Φ_c. by the replacement of one nl electron by n*1, such a replacement affecting only the radial part of the wave function. The orthogonality restrictions of the Hartree-Fock approximation prevent the satisfaction of Brillouin's theorem for some replacements such as nln'1LS → nl^2LS. A multi-configuration approximation then exists for which the theorem is valid. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

6123 (SFB-MHD-1) SPECIAL RESEARCH GROUP FOR MAGNETOHYDRODYNAMICS AT THE TECHNICAL UNIVERSITY OF BERLIN. Report for the Period 1970–1972. (Technische Univ. Berlin (F. R. Germany)). Dec 1972. 97p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

The Special Research Group for Magnetohydrodynamics, founded in May 1970, centralizes the entire West German research efforts in this particular field. The organization, funding, and first two years of operation are described. A brief survey is given of the ongoing work in Russia, USA, and France. At Berlin, specialized groups study MHD from the standpoint of liquid metals, energy conversion systems, two-phase dynamics, heat sources, alkali metal technology, and measuring techniques. (HBG)

6124 NONLINEAR SURFACE WAVES IN ELECTROHYDRODYNAMICS. Perel'man, T. L.; Fridman, A. Kh. (Inst. of Heat and Mass Exchange, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 8, 720-722(Aug 1973). (In Russian).

Approximate equations were obtained for the electrodynamics of shallow water. It was shown that the shape of isolated waves (peak or trough) depends not only on the sign of the dispersion but also on the coefficient of the nonlinear member. (tr-auth)

6125 CERTAIN PERTURBATION PROBLEMS AND SINGULAR EQUATIONS OF MAGNETOHYDRODYNAMICS. Sanchez-Palencia, E. (CNRS, Paris). J. Math. Anal. Appl.; 44: No. 1, 1-27(Oct 1973).

The problem of the limit behavior of magnetohydrodynamic flows past bodies at large Hartmann numbers M was studied, mainly in the case where the applied magnetic field is not uniformly as strong as $M \to \infty$. (MHR)

6126 THEORETICAL AND EXPERIMENTAL STUDIES OF THE LAMINAR FLOW OF AN ELECTRICALLY CONDUCTING INCOMPRESSIBLE FLUID SET IN MOTION IN A RESTRICTED MEDIUM BY THE UNIFORM ROTATION OF A DISK IN THE PRESENCE OF A MAGNETIC FIELD. Bas, J.; Bendaoud, M.; Vives, C. (College Scientifique Universitaire, Avignon, France). Compt. Rend., Ser. A, B; 277: No. 1, 73-76(2 Jul 1973). (In French).

Theoretical results relative to the laminar motion of an electrically conducting and incompressible fluid set in motion in a restricted medium by the slow and uniform rotation of a disk in the presence of an axial magnetic field are given for both the case of a finite and a nonexistent induced electric current. According to the electrical conditions, the experimental studies confirm the existence of a slowing-down or an acceleration of the fluid. (FR)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

6127 EVOLUTION OF QUANTUM SYSTEMS SUBJECT TO RANDOM MEASUREMENTS. Fonda, L. (Univ., Trieste, Italy); Ghirardi, G. C.; Rimini, A. (Nuovo Cim., 18B: No. 1, 1-10(11 Nov 1973).

Starting from the observation that in most experiments the physical system cannot be considered as evolving undisturbed, but that, on the contrary, it is subjected to repeated measurement processes at random times, a differential equation, and the corresponding integral equation, are derived for the density matrix describing such a situation. With some simple examples the big changes that the recognition of the presence of measuring processes yields in the physics of the system are recognized. (auth)

Electromagnetic

6128 (COO-2289-1) COULOMB DISSOCIATION OF HADRONS. Technical Progress Report. (Northwestern Univ., Evanston, Ill. (USA)). 1973. Contract AT(11-1)-2289. 27p. (CONF-730842-3). Dep. NTIS $3.50.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

Research activities on the Coulomb dissociation of hadrons is summarized. (JFP)

6129 (LAL-1268) SOME EXPERIMENTAL EVIDENCE OF VIRTUAL COMPTON SCATTERING OBTAINED AT 990 MeV WITH THE ORSAY STORAGE RING. Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Parrour, G.; Szklarz, G. (Ecole Normale Superieure, 91-Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

In order to check the analysis of previous data, the $e^+e^- \rightarrow \gamma\gamma$ annihilation cross section was measured. A significant fraction of the observed e-γ events does not arise from an experimental conversion of one of the photons of the 2γ channel. Using these events a good experimental confirmation of the theoretical expectations for the contribution of a quasi-real photon Compton scattering to the $e^+e^- \rightarrow e^+e^-\gamma$ reaction was obtained. (FR)

6130 (LNF-73/7) SOME RESULTS IN INCLUSIVE e^+e^- ANNIHILATION INTO HADRONS. Greco, M.; Srivastava, Y. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 22 Feb 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

e^+e^- annihilation into multihadrons is investigated through the energy-momentum conservation sum rules. Canonical scaling results for total cross section and $\overline{F}_1$, $\overline{F}_2$ are obtained and new scaling results for 2-particle inclusive processes are derived. Furthermore it is shown that hadronic multiplicities approach a constant value at high energies, for any scaling model. A sum rule is obtained connecting single and double pion production. Finally, in a self-consistent way, using FESR and EVMD model we estimate phenomenologically the pion form factor and structure function. A striking prediction is that near $x \simeq 1$, pion structure function $F_2^\pi(x)$ may be an order of magnitude or more larger than that of the proton. (auth)

6131 INELASTIC ELECTRON–PROTON SCATTERING IN THE REGION OF THE Δ(1236) RESONANCE. Dix. W. R. Hamburg; Univ. Hamburg (1972). 79p. (In German).

Thesis.

Absolute cross sections for inelastic electron–proton scattering were measured in the region of the first nucleon resonance at an electron scattering angle of 86° and for momentum transfer between 0.40 and 0.78 $(GeV/c)^2$. The W/region from W = 1.10 to W = 1.35 GeV was covered. Elastic and inelastic radiative corrections were applied to the measured cross sections. By combining these values with previous cross section measurements at an angle of 13.33° the contributions sigma(1) and sigma(t) could be separated over the entire q^2 and W ranges. The values obtained for sigma(1) and sigma(t) are compared with different models. It is found that the symmetric quark model of Ravndal does not reproduce the data very well. Better predictions are given by the dispersion theory models of Gutbrod and Simon and of v. Gehlen. (GE)

6132 VECTOR-MESON ELECTROPRODUCTION AT HIGH Q2. Ahrens, L.; Berkelman, K.; Brown, G. S.; Cassel, D. G.; Francis, W.R.; Garbincius, P.H.; Harding, D.; Hartill, D.L.; Hartmann, J.L.; Loveless, R.L.; Rohlfs, R.C.; White, D.H. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850); Sadoff, A.J. Phys. Rev. Lett. 31: No. 2, 131-133 (9 July 1973).

We have measured ρ^0,ω (combined) and ϕ electroproduction over a range of virtual-photon four-momentum Q^2 from 0.4 to 2.2 GeV^2 and for photon energies ν from 2.7 to 8.6 GeV. We find that the slope of the t (momentum transfer) dependence of the ρ^0 and ω forward peak decreases with increasing Q^2 to less than half of the photoproduction slope. (auth)

6133 MEASUREMENTS OF RECOIL PROTON POLARIZATION IN PHOTOPRODUCTION OF PIONS OFF THE NUCLEUS ^{12}C. Ananien, P. S.; Glavanakov, I. V.; Kryshkin, V. I.; Stibunov, V. N.; Sterligov, A. G.; Usov, Yu. P. (Inst. for Nuclear Physics, Tomsk, USSR). Lett. Nuovo Cim.; 8: No. 10, 651-654(3 Nov 1973).

Preliminary results on the measurements of recoil photon polarization in photoproduction of pions off protons and neutrons bound in the nucleus carbon-12 at 0.8 and 0.9 GeV maximum energy for incident photons are presented. (JFP)

6134 TOTAL AND PARTIAL γP CROSS SECTIONS AT 9.3 GeV. Bingham, H.H.; Fretter, W.B.; Podolsky, W.J.; Rabin, M.S.; Rosenfeld, A.H.; Smadja, G. (University of California and Lawrence Berkeley Laboratory, Berkeley, California 94720); Ballam, J.; Chadwick, G.B.; Eisenberg, Y.; Gearhart, R.; Kogan, E.; Moffeit, K.C.; Murray, J.J.; Seyboth, P.; Sinclair, C.K.; Skillicorn, I.O.; Spitzer, H.; Wolf, G. Phys. Rev. D 8: No. 5, 1277-1286 (1 Sept 1973).

We report γp total, topological, and channel cross sections at 9.3 GeV, from a bubble-chamber experiment using a nearly monoenergetic photon beam. (auth)

6135 RECONSIDERATION OF THE ELECTRON-NEUTRON SCATTERING LENGTH A_S MEASURED BY THE SCATTERING OF THERMAL NEUTRONS BY NOBLE GASES. Krohn, V.E.; Ringo, G.R. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 8: No. 5, 1305-1307 (1 Sept 1973).

Our value for the electron–neutron scattering length has been corrected on the basis of new measurements of some neutron scattering lengths and now is $(-1.30 \pm 0.03) \times 10^{-16}$ cm, which is 3% lower than our original result. (The equivalent figure in the Fermi convention is -3630 ± 70 eV and at $q = 0$, $dG_{E_n}/dq^2 = 0.0189 \pm 0.0004$ fm^2.) A check on the worrisome possibility of an H_2 impurity in the scattering gases showed that this is quite unlikely to be a significant source of error. The difference between our result and the Munich measurement and also the Foldy calculation thus continues unexplained. (auth)

6136 MULTIHADRON PRODUCTION IN e^+e^- COLLISIONS UP TO 3 GeV TOTAL CM ENERGY. Ceradini, F. (Univ., Rome); Conversi, M.; D'Angelo, S.; Paoluzi, L.; Santonico, R.; Visentin, R. Phys. Lett., B; 47B: No. 1, 80-84(15 Oct 1973).

New results on the multihadron production by electron and positron beams colliding with a total energy of up to 3 GeV are reported. Disregarding possible kaon final states, the ratio $\sigma_{mh}/\sigma_{\mu\mu}$ of the total multihadron cross section to the point-like cross section for process $e^+e^- \rightarrow \mu^+\mu^-$ has an average value of 1.58 ± 0.25 in the energy interval 2.6–3.0 GeV. The average charged multiplicity over this energy range is $\langle n_c \rangle = 2.9 \pm 0.3$. (auth)

6137 OBSERVATION OF THE CIRCULAR POLARIZATION CORRELATION OF THE POSITRON–ELECTRON ANNIHILATION QUANTA. Schmidt, G.; Simons, L. M. (Univ., Bonn). Z. Phys.; 263: No. 5, 387-394(1973).

The circular polarization-circular polarization angular correlation of annihilation quanta has been measured unambiguously by use of two backscattering Compton polarimeters in coincidence. The interpretation of the measurement required a quantum mechanical calculation of the circular polarization detection probability for coincident annihilation quanta. This calculation showed that the most favorable geometry for detecting a circular polarization correlation is the backscattering geometry because here, in contrast to forward scattering and transmission geometries, strong perturbations by the linear polarization correlation are not present. By using a polarization efficiency of 4.7% for a single polarimeter, which was derived from a Monte Carlo calculation, the measured effect for the circular polarization-circular polarization correlation showed good agreement with theory. (auth)

6138 COINCIDENCE MEASUREMENT OF THE ELEMENTARY PROCESS OF ELECTRON–ELECTRON BREMSSTRAHLUNG AT 300 keV. Nakel, W.; Pankau, E. (Univ., Tuebingen, Ger.). Z. Phys.; 264: No. 2, 139-153(1973). (In German).

The absolute cross section of electron-electron bremsstrahlung,

which is differential in all the free kinematical variables, was measured by using an electron-photon coincidence technique. An electron beam of 300 keV was used, incident on a carbon target. Within the experimental errors we found agreement with recent theoretical calculations. Simultaneously with the electron-electron bremsstrahlung the absolute cross section of electron-nucleus bremsstrahlung of carbon was measured. (auth)

Weak

6139 (KFKI-73-46) STUDY OF THE FORM FACTORS IN THE $K_{\mu 3}^+$ DECAYS. Albrecht, K. F.; Deak, F.; Genchev, V. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Aug 1973. 29p. (CONF-730943-3). Dep. NTIS (U. S. Sales Only) $3.50.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

A Dalitz plot analysis of 82,400 selected $K_{\mu 3}$ decays was carried out, which were observed in the Serpukhov neutral beam by means of a wire chamber magnetic spectrometer. The linear behavior of the form factors is demonstrated. Two possible solutions were obtained both for the scalar and the vector form factors. These solutions can be associated with the two mutually inconsistent results obtained earlier from similar experiments. One of the two solutions which is closer to the current K_{e3} data gives for the slopes of the vector and scalar form factors: $\lambda_+ = 0.046 \pm 0.008$ and $\lambda_0 = 0.024 \pm 0.011$. (auth)

6140 NEUTRINO-INDUCED MUONS DEEP UNDERGROUND. Bergeson, H.E.; Cassiday, G.L.; Hendricks, M.B. (Physics Department, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. Lett. 31: No. 1, 66-70 (2 July 1973).

We report here the results of a measurement of the integral energy distribution of the neutrino-induced muon flux deep underground using the Utah neutrino detector. Five neutrino-induced muon candidates have been obtained from the approximately 10^6 muons which have passed through the detector during 603 days of live operation out of 830 days total elapsed time. By comparing the observed and expected energy distributions we are able to set lower limits on the saturation energy E_0 of the total neutrino-nucleon cross section or, equivalently, on the mass M_W of the intermediate vector boson if scale invariance of the inelastic structure function νW_2 is assumed. We find at the 1σ, 2σ, and 3σ levels of confidence $E_0 > 320$, 80, and 29 GeV or $M_W > 10$, 5, and 3 GeV, respectively. (auth)

6141 OBSERVATION OF THE DECAY $K_L^0 \to \mu^+\mu^-$. Carithers, W.C.; Modis, T.; Nygren, D.R.; Pun, T.P.; Schwartz, E.L.; Sticker, H. (Columbia University, New York, New York 10533); Steinberger, J.; Weilhammer, P.; Cristenson, J.H. Phys. Rev. Lett. 30: No. 26, 1336-1340 (25 June 1973).

An experiment performed at the Brookhaven National Laboratory alternating-gradient synchrotron has yielded six events above negligible background which satisfy criteria for the decay $K_L^0 \to \mu^+\mu^-$. The K_L^0 flux, measured by means of the decay $K_L^0 \to \pi^+\pi^-$, leads to a value for the branching ratio $\Gamma(K_L^0 \to \mu^+\mu^-)/\Gamma(K_L \to \text{all}) = 11 \times 10^{-9}$. (auth)

6142 SALAM-WEINBERG MODEL OF WEAK INTERACTIONS AND STELLAR ENERGY LOSS RATES BY NEUTRINO PROCESSES. Biswas, S. N.; Chaudhuri, R. N.; Taank, J. K. S. (Univ. of Delhi). J. Phys., A (London); 6: No. 11, 1751-1762 (Nov 1973).

The energy loss mechanism from stellar bodies through neutrino emission processes has been discussed in the framework of the Salam-Weinberg unified symmetric model of weak and electromagnetic interactions. As a test of the model the effect of neutral currents in $\nu\bar{\nu}$ pair production for the process $\gamma + p \to p + \nu + \bar{\nu}$ has been considered; it is shown that although the cross section for this process at high energies (total centre of mass energy >2 BeV) is dependent on the structure of the vertices $\langle p'|J_\mu^Z|p\rangle$ and $\langle p'|J_\mu^A|p\rangle$, where J_μ^Z and J_μ^A are the weak neutral and electromagnetic currents respectively, the energy loss rate is not governed by them. The present calculation for the rate of energy loss by the γp reaction is in agreement with the rough estimate given by Dicus (Phys. Rev. D.; 6: 941-9 (1972)). However, it is an order of magnitude smaller than that calculated by Desrosiers and O'Donnell (Phys. Rev. D.; 2: 403-4 (1970)) using local interactions of hadrons with leptons through weak neutral currents. (auth)

6143 MEASUREMENT OF THE π_{e2} BRANCHING RATIO AND A FEASIBILITY STUDY OF A NEW PRECISION APPROACH TO MEASURING THE PION BETA DECAY BRANCHING RATIO. Wadlinger, E. A. Philadelphia; Univ. of Pennsylvania (1973). 260p. University Microfilms Order No. 73-24,234.

Thesis (Ph. D.).

A study was made of the feasibility of measuring the branching ratio for pion beta decay to better than 1% as a test of the conserved vector current hypothesis. Theoretical predictions for the pion beta decay rate are accurate to 1%. This precision results from the lack of other strongly interacting particles in the final state and from the small momentum transfer between the π^- and the π^0 allowing all strong interaction form factors to be set equal to unity. Decays of pions in flight were observed for a nominal pion momentum of 1.05 GeV/c. Previous beta decay measurements made on stopped pions suffered from a lack of knowledge of the efficiency for the detection of low energy gammas from the π^0 decays. At high momentum, the π^- produces, in flight, monoenergetic π^0's which decay giving high energy gammas peaked strongly at symmetry relative to the beam direction and at roughly equal lab energies. The gammas were detected by a counter with a well known efficiency. Because of the small branching ratio for this decay (10^{-8}), it is necessary to define and be able to eliminate significant backgrounds. The results of the feasibility study at PPA indicate that a measurement at the 1% level is possible. The experiment is scheduled to be performed at LAMPF within the next eighteen months. The well defined beam critical to this experiment was set up, tested, and found to perform as predicted. It was possible with the beam set up for the beta decay studies to measure the π_{e2} branching ratio. Electrons from the decays in flight were detected with a threshold Cherenkov counter followed by total energy absorbing shower counter. The two body kinematics gave essentially monoenergetic electrons. During the test fourteen π_{e2} events were collected which yielded a branching ratio of $(1.51 \pm .82) \times 10^{-4}$. (auth)

6144 MUON-PROTON SCATTERING AT HIGH MOMENTUM TRANSFERS. Kostoulas, I. G. Rochester, NY; Univ. of Rochester (1973). 245p. University Microfilms Order No. 73-25,820.

Thesis (Ph. D.).

An experiment was performed to search for muon-electron "universality" through a complete comparison of e-p and μ-p elastic and inelastic scattering. The experiment was performed at Brookhaven National Laboratory where a special muon beam was constructed yielding up to 3×10^6 muons/AGS pulse, incident on a 48" hydrogen target. The μ-p scattering events were detected using a combination of spark chambers and hodoscope spectrometers. A total of 621 elastic and 9419 inelastic events in the four momentum transfer (q^2) region up to 3.5 $(\text{GeV/c})^2$ and with energy loss ν up to 6.0 GeV/c. Data were taken at incident momenta $7.25 \pm .77$ and $5.8 \pm .60$ GeV/c. The data demonstrate close similarity with electron-proton scattering, the behavior in q^2 and ν being identical. Comparison of the elastic data with the e-p scattering experiments indicates agreement within the error of measurement (both for the electron and muon data). However the μ-p elastic cross-section is lower by about 6% as in previous μ-p experiments. This discrepancy is at the limit of the relative normalization error. The inelastic scattering indicates that the structure function νW_2 of the proton is not a function of q^2 and ν separately but a function of the dimensionless ratio $\omega = 2m_p\nu/q^2$. Namely, as q^2 and ν are scaled proportionally, νW_2 remains invariant which behavior is completely different from elastic scattering. Such behavior of the structure function νW_2 and the large values of the inelastic scattering cross-section at high q^2 can be accounted for by assuming that the nucleon consists of point like charged particles, the "partons". (auth)

6145 EXPERIMENTAL STUDY OF THE RARE K^+ DECAY MODES: $K^+ \to \pi^+\pi^0\gamma$, $K^+ \to \mu^+\pi^0\nu\gamma$, $K^+ \to \pi^+\gamma\gamma$, $K^+ \to \pi^+\nu\bar{\nu}$, $K^+ \to \pi^0\pi^0 e^+\nu$, AND $K^+ \to e^+\pi^0\nu\gamma$. Ljung, D.; Cline, D. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. D 8: No. 5, 1307-1330 (1 Sept 1973).

Six rare stopped-K^+ decays have been studied in the 40-inch heavy-liquid bubble chamber at Argonne National Laboratory. The chamber was filled with CF_3Br. Twenty-two radiative $K_{\pi 2}$ events with three converted γ rays were analyzed. The experiment was sensitive to positive pions with kinetic energy 55 to 102 MeV. The strengths (γ and β) of the direct processes in the decay were determined to be $\gamma = -0.02^{+0.17}_{-0.43}$, $\beta = 0.0 \pm 0.3$, and the branching ratio is $(1.5^{+1.1}_{-0.4}) \times 10^{-4}$ for $55 < \overline{T}_{\pi^+} < 80$ MeV. These results are consistent with assuming the decay is dominated by internal bremsstrahlung. No events were found in the search for $K^+ \to \mu^+\pi^0\nu\gamma$ and the upper limit on the branching ratio is reported as 6.1×10^{-5} for γ energies greater than 30 MeV. No examples of the $K^+ \to \pi^+\gamma\gamma$ decay mode were found. The experiment was sensitive to pions with kinetic energy 6 to 102 and 114 to 127 MeV. The null result allowed us to discard several theoretical models which made branching-ratio predictions for this decay. Assuming a phase-space model for the pion spectrum the upper limit is 3.5×10^{-5}. The upper limit on the neutral current decay $K^+ \to \pi^+\nu\bar{\nu}$ is reported as 5.7×10^{-5} assuming a vector interaction. The decay $K^+ \to \pi^0\pi^0 e^+\nu$ was observed for the first time. Two events were found in which all four converted γ's were seen. These two events give a branching ratio of $(1.8^{+2.4}_{-0.8}) \times 10^{-5}$ for this decay. The form factor f_1 for the decay is $|f_1| = 0.97^{+0.80}_{-0.19}$. These results are in good agreement with $\Delta I = 1/2$ rule predictions. Seventeen $K^+ \to e^+\pi^0\nu\gamma$ events were observed. The branching ratio is

reported as $\Gamma(K^+ \to e^+\pi^0\nu\gamma)/\Gamma(K^+ \to e^+\pi^0\nu) = (0.48 \pm 0.20) \times 10^{-2}$ for $E_\gamma > 30$ MeV and $\cos\theta_{e\gamma} < 0.9$. (auth)

6146 MEASUREMENT OF THE K_S BRANCHING RATIO. Hill, D.G.; Sakitt, M.; Samios, N.P. (Brookhaven National Laboratory, Upton, New York 11973); Burris, R.W.; Engler, A.; Kraemer, R.W.; Meltzer, C.M. Phys. Rev. D 8: No. 5, 1290-1300 (1 Sept 1973).

A precise measurement of the K_S branching ratio was obtained from an exposure of the 30-inch bubble chamber, filled with deuterium, to a 600-MeV/c K^+ beam at the Brookhaven AGS. Approximately 30000 events, corresponding to the reaction $K^+ + d \to K^0 + p + p$, where both protons stopped in the bubble chamber, were found and processed. Based upon a final sample of 16,475 events which passed the various selection criteria, we find that $\Gamma(K_S \to \pi^+ + \pi^-)/\Gamma(K_S \to \pi^0 + \pi^0) = 2.16 \pm 0.08$. (auth)

Strong (Baryon-induced)

6147 (JINR-E1-7304) REACTION dp → ppn at 3.3-GeV/c DEUTERON MOMENTUM. Aladashvili, B. S.; Glagolev, V. V.; Lebedev, R. M.; Nassal'ski, Ya.; Nioradze, M. S.; Saitov, I. S.; Sandach, A.; Semyarchuk, T.; Stepanyak, I.; Strel'tsov, V. N.; Zelinski, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The experimental data on the study of the reaction dp → ppn in the hydrogen bubble chamber at the incident deuteron momentum of 3.3 GeV/c are presented. The angular and momentum distributions of nucleon-spectators, the Treiman-Yang angle distributions as well as the differential cross sections are reported. (auth)

6148 WHAT HAPPENS WHEN A 10^{15} eV PROTON HITS A NUCLEUS? Lehman, E. (Univ. of Manchester, Eng.); Winbow, G. A. Phys. Lett.; 46B: No. 3, 372-376(1 Oct 1973).

It is suggested that intra-nuclear cascading produces very high multiplicities in processes where a very fast cosmic ray proton strikes a nuclear target. Only particles produced in the central region of the production process are expected to participate in the cascade. (auth)

6149 COHERENT GENERATION OF PARTICLES ON EMULSION NUCLEI BY 200 GeV/c PROTONS. Alma Ata–Leningrad–Moscow-Tashkent Collaboration. JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 10-12(5 Jul 1973).

Translation of Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 19-24(5 Jul 1973).

Type BR-2 nuclear emulsions were bombarded in the NAL accelerator by 200-GeV/c protons. By comparing the multiplicity and angular-characteristics distributions of pp and pn interactions on 1438 m of primary tracks, it is found that the ranges for coherent generation of three and five charged particles are $\lambda_3 = (21.8^{+3.3}_{-2.5})$ and $\lambda_5 = (68^{+25}_{-16})$ meters, respectively. (auth)

6150 TRANSVERSE-MOMENTUM DISTRIBUTION OF PIONS IN HIGH-ENERGY pp COLLISIONS. Duong-van, M.; Carruthers, P. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 31: No. 2, 133-135 (9 July 1973).

The inclusive π^0 transverse-momentum distribution at 90° in pp collisions of c.m. energy 53.4 GeV is shown to be described over 10 orders of magnitude by a Gaussian distribution in the transverse rapidity variable $\gamma_\perp = \tanh^{-1}(p_\perp/E)$. (auth)

6151 PROTON INTERACTIONS AT HIGH ENERGIES. Amaldi, U. Sci. Amer.; 229: No. 5, 36-44(Nov 1973).

The background, the results, and the meaning of two recent experiments performed in the new CERN colliding-beam accelerator are described. The experiments, which involved collisions between oppositely directed beams of high-energy protons, have revealed a new and unexpected property of the strong interaction at extremely high energies. The results obtained so far have shown that above a certain energy the probability that two passing protons will interact increases with energy, a finding that may require a major revision in the accepted description of high-energy nuclear interactions. (LBS)

6152 LARGE MOMENTUM TRANSFER π^+p, K^+p, AND pp ELASTIC DIFFERENTIAL CROSS SECTIONS AT 13.8 GeV/c. Cornillon, P. C. Ithaca, NY; Cornell Univ. (1973). 124p. University Microfilms Order No. 73-28,290.

Thesis (Ph. D.).

The objective of the experiment, part of which is described in this thesis, was to measure the π^+p and the π^-p elastic differential cross sections at 13.8 GeV/c for $-4.0 < t < -0.7$ $(GeV/c)^2$ and the π^-p elastic differential cross section at 22.6 GeV/c for $-4.0 < t < -0.2$ $(GeV/c)^2$. This thesis discusses specifically the relation between the 13.8 GeV/c π^+p and π^-p elastic differential cross sections, and it discusses briefly the K^+p and the pp 13.8 GeV/c elastic differential cross sections. The most interesting result of this experiment is the statistically significant difference between the 13.8 GeV/c π^+p and the 13.8 GeV/c π^-p elastic differential cross sections in the t range from -2.2 to -3.3 $(GeV/c)^2$. Previous experiments indicate that at 9 GeV/c and at 5 GeV/c the π^-p elastic differential cross section shows a striking dip at $t \approx -2.8$ $(GeV/c)^2$ and at 5 GeV/c the π^+p elastic differential cross section also shows a dip for $t \approx -2.8$ $(GeV/c)^2$. At 13.8 GeV/c this dip has disappeared for π^+p but is still present for π^-p. Our experiment further indicates that at 22.6 GeV/c the dip has also disappeared for the π^-p cross section. The 13.8 GeV/c K^+p elastic cross section for $-2.4 < t < -0.6$ $(GeV/c)^2$ was measured. The interesting result of this measurement is that for $t < -0.9$ $(GeV/C)^2$ the cross section is to within statistics identical to the π^-p elastic cross section. The 13.8 GeV/c pp elastic cross section for $-0.8 > t > -1.1$ $(GeV/c)^2$ agrees quite well with the results of Allaby et al. The cross section, however, is about 30% below that of Allaby et al., for $t < -1.1$ $(GeV/c)^2$. We cannot resolve this discrepancy. (auth)

6153 PION PRODUCTION IN THREE PRONG EVENTS OF np AND K_Lp INTERACTIONS. Fesesse, T. Minneapolis; Univ. of Minnesota (1973). 105p. University Microfilms Order No. 73-25,605.

Thesis (Ph. D.).

This paper is based on the analysis of a sample of about 14,000 events out of a total of over 2×10^6 pictures taken in the 85 cm. Deuches Elektronen Synchrotron (DESY) liquid hydrogen bubble chamber in the years 1970–1972 at Hamburg, Germany. The chamber was exposed to a secondary beam of fast neutrons and neutral kaons which were initially produced by bombarding a beryllium target with a 4.5 GeV electron beam. The 3 prong events which were very much abundant in the film were fitted to the following hypotheses: 1) $np \to pp\pi^-$, 2) $np \to d\pi^+\pi^-$, 3) $K^0p \to pK^+\pi^-$, 4) $\bar{K}^0p \to p\pi^+K^-$, 5) $np \to p\pi^-\pi^0$, and 6) $np \to p\pi^+\pi^-n$. Data reduction for these reactions were carried out using the BRL SIOUX-ARROW program sequence. All computations were made on the CDC 6600 computer at the University of Minnesota. Because the neutron beam momentum was not well defined only 3C constraints could be imposed in the fittings of the first four reactions. However, in the last two reactions only O–C fits were possible. All ambiguities between one of the reactions (1) to (4) and any one of the reactions (5) to (6) were decided in favor of the higher constrained reaction. In all the reactions studied, namely (1) to (4), agreement is sought to various types of particle exchange models describing high energy phenomena. (auth)

6154 NEW EXPERIMENTAL RESULTS ON $\bar{p}p \to K^0\bar{K}^0$ FROM 700 TO 1100 MeV/c. Burns, R.R.; Condon, P.E.; Donahue, J.; Mandelkern, M.; Price, L.R.; Schultz, J. (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. D 8: No. 5, 1286-1289 (1 Sept 1973).

Cross sections and angular data are presented for proton–antiproton annihilation into K_SK_L and K_SK_S at six laboratory momenta from 686 to 1098 MeV/c. Unlike results reported elsewhere, the rates for C = −1 and C = + 1 states are found to be comparable within statistics. Also, evidence is presented that at least several waves contribute to the direct-channel amplitude with different isospin as well as angular momentum quantum numbers. (auth)

6155 NUCLEON–NUCLEON SCATTERING NEAR 50 MeV. I. PHASE SHIFT ANALYSIS OF THE DATA. Arndt, R.A. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061); Binstock, J.; Bryan, R. Phys. Rev. D 8: No. 5, 1397-1408 (1 Sept 1973).

We carry out a phase-shift analysis of p–p and n–p elastic scattering data in the laboratory kinetic energy range of 47.5 to 60.9 MeV. Despite the inclusion of new n–p total and differential cross-section data since the phase-shift analyses of MacGregor, Arndt, and Wright (papers VI and X in particular), the χ^2 vs ϵ_1 curve retains its double minimum, and the anomalous value for the phase parameter $\delta(^1P_1)$ persists. The data yield a range of solutions rather than a unique I = 0 phase-shift solution, and, in fact, the χ^2 vs ϵ_1 curve is even flatter than it was in paper VI. The allowed range of ϵ_1 is found to be from − 10 ° to + 3°, approximately. To find a unique solution, we constrain ϵ_1 to have a reasonable theoretical value of + 2.78 °, and present the corresponding constrained phase-shift solution. This yields $\delta(^1P_1) = -3.52° \pm 1.04°$, which is 4.5 standard deviations or more above predictions by meson theoretical models. In fact, throughout the allowed range of ϵ_1, the searched value of $\delta(^1P_1)$ remains at least this far above theoretical predictions. We determine that the Harwell n–p $d\sigma/d\Omega$ data at extreme forward and extreme backward angles are responsible for the high value of $\delta(^1P_1)$, and recommend that these measurements be retaken. We emphasize that contrary to popular belief, it is not sufficient just to fix the relative backward n–p $d\sigma/d\Omega$, because incorrect forward values will

result in a wrong value for δ ($^1P_1$). With regard to forward data, good extreme forward absolute $d\sigma/d\Omega$ data will be more effective than relative forward data spanning the 0 °–90 ° range. Finally, with respect to ϵ_1, we emphasize that the existing types of n–p data ($d\sigma/d\Omega$, σ_{tot}, and P) will not remove the ambiguity in this phase parameter. Some other type of experiment must be done, as we intend to discuss in a succeeding paper. (auth)

6156 LARGE-ANGLE INCLUSIVE PRODUCTION OF CHARGED PIONS AT THE CERN ISR WITH TRANSVERSE MOMENTA LESS THAN 1.0 GeV/c. Alper, B.; Hoggild, H.; Booth, P. (CERN, Geneva). Phys. Lett.; 47B: No. 1, 75-79(15 Oct 1973).

The inclusive production of $\pi^\pm$ in proton-proton collisions was measured for the transverse momentum range 0.15 to 1.0 GeV/c over an angular range of 29° to 89° in the center-of-mass system and for center-of-mass energies $\sqrt{s}$ = 30.6 and 52.8 GeV. For each energy the invariant cross section foe fixed transverse momentum was found to increase by about 15% as the center-of-mass rapidity decreases from 1 to 0, i.e., the "central plateau" has not yet been reached. (auth)

Strong (Meson-induced)

6157 (BNL-18183) AMPLITUDE ANALYSIS OF HYPERCHARGE EXCHANGE REACTIONS. Field, R. D.; Chung, S. U.; Eisner, R. L.; Rouge, A.; Videau, H.; Aguilar-Benitez, M.; Barreiro, F.; Rubio, J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 24p. (CONF-730943-2). Dep. NTIS $3.25.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Results on a transversity amplitude analysis of final states produced in $K^- + p \to \Lambda + \phi(\omega)$ and $K^- + p \to \Sigma^+(1385) + \pi^-$ interactions at 3.9 to 4.6 GeV/c are presented. (JFP)

6158 (BNL-18188) FORWARD NEUTRAL VEE PRODUCTION BY NEGATIVE PIONS AT 24 GeV/c. Kramer, M. A.; Foley, K. J.; Love, W. A.; Ozaki, S.; Platner, E. D.; Saulys, A. C.; Willen, E. H.; Lindenbaum, S. J.; Mallik, U.; Margulies, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 8p. (CONF-730837-6). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Preliminary results are given on the $K^0_1K^0_1$ spectrum and the missing-mass spectrum for the interactions $\pi^- + p \to K^0_1$ + charged particles + missing mass and $\pi^- + p \to K^+ + K^- + \pi^-$ + missing mass at 24 GeV/c. (JFP)

6159 (BNL-18210) RESULTS ON NEUTRAL ASSOCIATED PRODUCTION AND PLAN FOR BNL MULTIPARTICLE SPECTROMETER PROJECT: OUR SPECTROMETER PROGRAM, PAST AND FUTURE. Ozaki, S. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1973. 37p. (CONF-730731-1). Dep. NTIS $4.00.

From international symposium on high energy physics; Tokyo, Japan (23 Jul 1973).

The forward arm of the double vee magnetic spectrometer at AGS was used to investigate the reactions $\pi^-p \to K^0_2\Lambda(\Sigma)$, $K^0_2 \to \pi^+\pi^-$ at 8.0, 10.7, and 15.7 GeV/c. Results are presented for $\pi^+\pi^-$ mass distributions, differential cross sections, and total cross sections. The total cross sections for the reactions $K^+p \to K^0\Delta^{++}$, $K^-p \to K^0n$, and $K^-p \to K^0\Delta^0$ also studied in a similar topology are presented. Plans for the new multiparticle spectrometer facility at Brookhaven National Laboratory under construction are also discussed. (LBS)

6160 (DNPL/R-30, pp 123-156) ROLE OF PION EXCHANGE IN MULTI-PARTICLE PRODUCTION. Kittel, W. (CERN, Geneva). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

Due to the large amount of data which has recently been obtained on multi-particle production, the mere presentation of these data provide a major challenge. Of the several approaches tried, a global but still qualitative picture is emerging from a largely model-independent but systematic data presentation and analysis. Attempts are now being made toward the quantitative description of these data simultaneously in all essential dimensions of the matrix element. The difficulties in the special case of pion exchange are demonstrated for three and four body final states as well as in inclusive reactions. The presentation of data in longitudinal phase space and their classification into individual phase space sectors is considered and the fit of the correlations in longitudinal phase shift discussed. (UK)

6161 (JINR-E1-7353) NEUTRAL KAON REGENERATION ON CARBON IN THE MOMENTUM REGION OF 16 TO 40 GeV/c. Albrecht, K. F.; Birulev, V. K.; Deak, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 19p. (CONF-730943-1). Dep. NTIS (U. S. Sales Only) $3.00.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The absolute value and the phase of the regeneration amplitude $K^0_L - K^0_S$ on carbon were measured. In the momentum range 16 to 40 GeV/c the phase is constant within the limits of experimental errors and coincides with the regeneration phase on hydrogen. Both the absolute value and the phase of the regeneration amplitude on carbon are in agreement with optical model calculations. (auth)

6162 (LBL-2112) DIFFRACTION DISSOCIATION IN 205 GeV/c π^-p TWO- AND FOUR-PRONG INTERACTIONS. Abrams, G. S.; Bingham, H. H.; Chew, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 10 Aug 1973. Contract W-7405-eng-48. 29p. (CONF-730837-7). Dep. NTIS $3.50.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Data are presented on diffraction dissociation in $\pi^-p \to \pi^-p$ and $\pi^-p \to \pi^-\pi^-\pi^+p$ interactions at 205 GeV/c. Mass spectra and cross sections for pion dissociation and nuclear dissociation are presented. (LBS)

6163 (NP-19792) CHARACTERISTICS OF K^0s PRODUCTION IN K^+p INTERACTIONS AT 8.2 GeV/c AND K^-p INTERACTIONS AT 10.1 GeV/c. Stroynowski, R. (Geneva Univ. (Switzerland)). 1973. 89p. Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

A study of the charge-exchange inclusive interactions $K^-p \to \overline{K}^0 + x^0$ at 10.1 GeV/c and $K^+p \to K^0 + x^{++}$ at 8.2 GeV/c is presented. The experimental procedure for obtaining and processing the data is described. The determination of the cross sections is described and the general characteristics of the K^0 mesons produced in both experiments are discussed. A comparison is made with phase-space predictions. The main results of the analysis are summarized. (LBS)

6164 INCLUSIVE STUDIES IN 13 GeV/c K^- PROTON INTERACTIONS. Johnson, M. E. New Haven; Yale Univ. (1973). 167p. University Microfilms Order No. 73-26,654.

Thesis (Ph. D.).

Data is presented on single particle inclusive cross sections for Λ, K^0_s, $\bar{\pi}^+$, and Ξ^- production in K^-p reactions at 13 GeV/c. Evidence is found for a rising diffractive contribution to the total Λ cross section when Λ production in this experiment is compared to other K^-p experiments at lower energies and to 13 GeV/c K^+p data. A net negative polarization is obtained for Λ's produced in the forward hemisphere. Transverse momentum distributions for Λ's, K^0_s's, and π^+'s are included as well as two particle correlations for $K^0_s\pi^-$, $\Lambda\pi^+$, and ΛK^+_s production. No obvious correlations are found either with resonance production or other dynamics. (auth) (Diss. Abstr. Int., B)

6165 MEASUREMENTS OF THE POLARIZATION PARAMETER IN π^+p ELASTIC SCATTERING BETWEEN 2.50 AND 5.15 GeV/c. Scheid, J.A.; Booth, N.E.; Conforto, G.; Esterling, R.J.; Parry, J.H.; Sherden, D.J. (The Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637); Yokosawa, A. Phys. Rev. D 8: No. 5, 1263-1277 (1 Sept 1973).

The polarization parameter in π^+p elastic scattering has been measured at several momenta in the range 2.50–5.15 GeV/c pion laboratory momentum and covering the range in t approximately from –0.2 to –2.0 $(GeV/c)^2$. The data show positive polarization for π^+p scattering, having a dip near t = – 0.6 $(GeV/c)^2$ and becoming relatively large at greater values of – t. The results for π^+ and π^- scattering are approximately equal in magnitude but of opposite sign. The data have been analyzed to separate the components, which are symmetric and antisymmetric with respect to pion charge, and to show both the t and s dependence of each part. (auth)

6166 LARGE-ANGLE K^+p ELASTIC SCATTERING AT 10 GeV/c. Baglin, C.; Briandet, P.; Carlson, P. J. (Cern, Geneva). Phys. Lett.; 47B: No. 1, 89-92(15 Oct 1973).

K^+p elastic scattering has been measured over nearly the whole angular range at an incident momentum of 10 GeV/c. The differential cross-section is found to decrease smoothly in the forward direction to $-t \approx 2$ $(GeV/c)^2$, where there is a change in slope, followed by a further decrease to $-t \approx 6$ $(GeV/c)^2$. Around 90° c.m. the cross-section is approximately 1 nb/$(GeV/c)^2$, which is more than two orders of magnitude lower than at 5 GeV/c. The backward peak has no structure. (auth)

6167 LARGE-ANGLE π^+p ELASTIC SCATTERING AT 10 GeV/c. Baglin, C.; Briandet, P.; Carlson, P. J. (CERN, Geneva). Phys. Lett.; 47B: No. 1, 85-88(15 Oct 1973).

The angular distribution of π^+p elastic scattering was measured

at an incident momentum of 10 GeV/c. Nearly the whole angular range was covered in one experimental set-up. The pronounced dip at $-t = 2.8$ (GeV/c)^2, observed at lower momenta, has diminished and is essentially a shoulder at 10 GeV/c. The other structure at larger momentum transfers are also different in detail from what was observed at 5 GeV/c. In the 90° c.m. region the differential cross section is approximately one nb/(GeV/c)^2, which is more than two orders of magnitude lower than at 5 GeV/c. (auth)

Particle Interactions and Properties (Theoretical)

6168 NOTE ON RESONANCE ANGULAR DISTRIBUTIONS WITH APPLICATION TO NUCLEON ANTINUCLEON SCATTERING AND ANNIHILATION. Peaslee, D. C.; Rosalky, D. M. (Australian National Univ., Canberra). Aust. J. Phys.; 26: No. 4, 441-448(Aug 1973).

Angular distributions were calculated for the reactions $\bar{N}N \to \bar{N}N$ and $\bar{N}N \to 2$ pseudoscalar mesons by assuming the formation of an intermediate isolated state. The scattering distributions are only found to have the characteristic oscillatory shape for unnatural parity resonances whereas those for natural parity states are smooth. The annihilation distributions display an exact degeneracy with respect to the interchange of orbital and total angular momenta. For both reactions, the width of the forward and backward peak is approximately inversely proportional to the resonance spin. (auth)

General

6169 (BNL-18230) LIGHT CONE PHYSICS. Where Do We Stand? Preparata, G. (Brookhaven National Lab., Upton, N. Y. (USA)). Sep 1973. 48p. (CONF-730842-2). Dep. NTIS $4.50.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

The review of light cone physics covers various aspects which are physically interesting, evaluation of the importance of the ideas which form the nucleus of light cone physics, understanding of the limitations and an analysis of possible ways to overcome the difficulties of light cone physics. (JFP)

6170 EXCLUSIVE INTERACTION. Barker, W. A. (Univ. of Santa Clara, CA). Int. J. Theor. Phys.; 8: No. 2, 141-146(1973).

It is proposed that there exists a fifth basic interaction from which the Pauli exclusion principle can be deduced. Such an interaction would affect only particles of half integral spin, whose total number is less than the number of particles which participate directly in the strong interaction. This is the reason for choosing the name exclusive interaction, which, like the strong interaction, would be expected to obey a relatively large number of conservation laws and symmetry principles. The tentative mathematical expression for this interaction $[V(r,\sigma) = g/r \cos(cr)\exp(-r/R)\ (1 + \sigma_1 \cdot \sigma_2/2)]$ is suggested by a discussion of fermion-fermion scattering in the Born approximation. It is found that a potential energy of this form may be used instead of antisymmetrizing the wave function in the manner required by the Pauli principle. An investigation of the binding of helium-like atoms is expected to lead to a determination of the relative strength $g/\hbar c$ and the range R of this interaction. (auth)

6171 IMPROVEMENT OF EVIDENCE FOR THE EMPIRICAL MASS FORMULA m APPROX. = N × 3m$_e$ FOR STABLE PARTICLES. Frosch, R. (Swiss Inst. for Nuclear Research, Villigen). Lett. Nuovo Cim.; 8: No. 10, 633-638(3 Nov 1973).

An improved version of the statistical tests of R Frosch Nuovo Cimento 52A, 677 (1967) is presented, and these tests are applied to the particle masses compiled by the Particle Data Group in the Reviews of Modern Physics. The mass formula under discussion is $m_i = (N_i + x_i)3m_e$, where m_i is one of the 15 stable particle masses specified, N_i is an integer, and x_i is a small positive or negative number. (JFP)

6172 ROLE OF DIFFRACTION CONTRIBUTIONS TO INELASTIC PROCESSES AT HIGH ENERGIES. Mandzhavidze, I. D. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 35-37(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 64-67(5 Jul 1973).

The limiting hadron multiplicity n_0 at which the hypothesis of the finite longitudinal correlation radius in momentum space is applicable is investigated from the point of view of the sum rules that relate the partial cross sections with the differential cross sections of "inclusive" processes. It is shown that such a picture of inelastic interactions can be valid in a region of multiplicity values that is broader than the region of the main maximum: $\bar{n} - n_0 > \sqrt{a \ln s/s_0}$. Thus, $n_0 = 3 - 4$ at an average multiplicity $\bar{n} = 10$. (auth)

6173 CLASSIFICATION OF ELEMENTARY PARTICLES. Teleman, C.; Teleman, M. (Univ., Bucharest). Compt. Rend., Ser. A, B; 277: No. 1, 81-82(2 Jul 1973). (In French).

The classification begun previously is completed. The form of the operators introduced obeys the Gell-Mann principle which requires masses to be considered in any classification of elementary particles. (auth)

6174 UNITARITY CORRECTIONS TO APPROXIMATE AMPLITUDES IN MULTICHANNEL SCATTERING. Lichtenberg, D. B. (Indiana Univ., Bloomington). Particles Nucl.; 5: No. 4, 119-136(Apr 1973).

Use is made of the unitarity of the multichannel S matrix to calculate correction terms to the Born approximation result for elastic scattering. It is shown that the corrections can differ appreciably from those made in the usual absorptive model. (auth)

6175 PHYSICS IN PERSPECTIVE. Volume II, Part A. Core Subfields of Physics. Washington, DC; National Academy of Sciences (1973). 756p. $13.50.

The topics cover elementary-particle, nuclear, atomic, electron, and molecule physics, physics of condensed matter, optics, acoustics, plasma physics, and physics of fluids. (JFP)

Electromagnetic

Refer also to abstracts 6782 and 6834.

6176 (DNPL/R-30) PROCEEDINGS OF THE PION EXCHANGE MEETING HELD AT DARESBURY LABORATORY, 23 MARCH 1973. Daresbury Study Weekend Series No. 6. Winbow, G. A. (ed.). (Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). 1973. 161p. (CONF-730347-).

The object of the conference was to bring together people working on the very different reactions in which pions can be exchanged and, as far as possible, to obtain a unified view of this area. Six papers were presented for which separate abstracts have been prepared. (UK)

For abstracts of individual papers see: 6160, 6177–6179, 6240, and 6241.

6177 (DNPL/R-30, pp 1-31) PION EXCHANGE IN PION PHOTOPRODUCTION AND ELECTROPRODUCTION AND THE DETERMINATION OF THE PION FORM FACTOR. Berends, F. A. (Leiden Univ., Netherlands). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

Evidence is given of pion exchange in those photo- and electroproduction reactions where the photon couples to two pions and thus some information on the pion form factor can be obtained. The real or virtual photon reactions considered are $\gamma + p(n) \to \pi^+ + n(p)$ and $\gamma + p(n) \to \pi^+ + \Delta^{0,++}\ (\Delta^{-,+})$. After reviewing the experimental quantities for coincidence electroproduction experiments of the above type, the various commonly used amplitudes for these reactions are introduced. Since the essential features can be explained by considering only scalar particles this approach is chosen in order to avoid a large number of amplitudes. The characteristics of pion exchange can also be demonstrated in that way. Then, for realistic reactions like the above some assumptions about those amplitudes which do not contain pion exchange have to be made. The simplest possible assumptions lead to so-called electric Born models or to models which also contain some corrections to the former. Pion exchange in these models is pure pion exchange and not Reggeized pion exchange. The justification for this lies in its simplicity, the small number of parameters and the agreement with experiment in the small t-ranges considered. The models are closest in spirit to peripheral pion exchange with some absorption. The parameters are certain form factors which by comparison to experiment can be determined. Besides this model dependent determination of the strength of pion exchange from high energy reactions in the forward direction, also the low energy determination of this strength is discussed. (UK)

6178 (DNPL/R-30, pp 33-38) PION POLE IN ELECTROPRODUCTION ACCORDING TO CURRENT ALGEBRA AND DISPERSION THEORY: SOME RECENT RESULTS. Dombey, N. (Univ. of Sussex, Brighton, Eng.). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

A brief report is given on work carried out during 1971-72 on

the PCAC-current algebra approach to pion electroproduction and in particular, the problem of the pion pole. (UK)

6179 (DNPL/R-30, pp 39-64) PION EXCHANGE IN PHOTOPRODUCTION AND DIPION PRODUCTION. Worden, R. (Rutherford High Energy Lab., Chilton, Eng.). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

Charged pion photoproduction is a particularly good reaction in which to study pion-exchange amplitudes for a number of reasons; (a) the high quality and wide range of the data, (b) measurements have been made with polarized photons for both processes ($\gamma p \to \pi^+ n$ and $\gamma n \to \pi^- p$) and with polarized targets, (c) low energy phase shift analyses exist, permitting tests of high energy models by FESRs, (d) the process is related by vector dominance to the well-studied process $\pi^- p \to \rho^0 n$. It is shown that a Regge pole model, with Poor Man's Absorption (PMA) of the non-flip amplitude, simply describes all near-forward charged photoproduction data and FESRs. The same data are equally well described by a conventional strong absorption model. In this model, the low partial-waves need not be over-absorbed to give the correct size of the forward non-flip amplitude. A large part of this amplitude typically 40%) comes from absorption of A_2 exchange. The A_2 pole amplitude required for this is not implausibly large, but agrees well with other constraints, such as exchange degeneracy. In the reactions $\pi^- p \to f^0 n$, $g^0 n$, where the data show less absorption than predicted by PMA, the conventional strong absorption model (including A_2 contributions) may help in understanding the data. In particular, missing-mass duality suggests that the A_2 pole contribution may be weaker in f and g production than in ρ production. This leads to a smaller ($\pi + A_2$) absorptive amplitude, in qualitative agreement with the data. (UK)

6180 (DNPL/R-31) PARTONS AND QUARKS. Daresbury Lecture Note Series No. 12. Close, F. E. (Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). 1973. 116p. Dep. NTIS (U. S. Sales Only) $8.00.

The report is based on a series of lectures given at Daresbury Laboratory on 2 to 12 April 1973. It is stated that the purpose was to show the reasons why parton models describe the data, show what other phenomena can be understood and what predictions can be made within the parton hypothesis. The report is in sections: elastic electron scattering; inelastic electron scattering; deep inelastic scattering and partons; structure functions and sum rules in the quark parton model; inelastic neutrino scattering; forward Compton scattering; Compton scattering in simple models; a J = 0 fixed pole in Compton scattering; the non-perturbative parton model without tears; the parton model and vector-meson dominance-rivals or partners; do resonances scale; resonances, SU(6) and the quark parton model; towards a dynamical parton model. (UK)

6181 (JINR-E2-7247) SUM RULES FROM LIGHT-CONE CURRENT ANTICOMMUTATORS. Gerasimov, S. B.; Moulin, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (CONF-730842-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

A set of sum rules for the virtual Compton scattering amplitudes is obtained on the basis of an investigation of the vector current anticommutator matrix elements and of the corresponding structure functions. The light-cone current anticommutator structure is abstracted from the quark free field theory model. Comparison with parton model results is discussed. (auth)

6182 (LNF-73/12) DEEP INELASTIC STRUCTURE FUNCTIONS FROM COLLINEAR SU(1,1) SYMMETRY. De Francheschi, G.; Etim, E.; Ferrara, S. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Apr 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

A model of deep inelastic processes is exhibited, based on conformal symmetry arguments, in which the structure functions for the scattering and annihilation channels both scale and are related by the Gribov-Lipatov relation. Analytic continuation is however not valid in general. (auth)

6183 (LNF-73/13) GRIBOV–LIPATOV RECIPROCITY FROM CONSERVATION CONSTRAINTS AND O(4) SYMMETRY. Etim, E. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 10 Apr 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The physical basis of the Gribov-Lipatov reciprocity is traced to energy-momentum conservation, N-plane analyticity and O(4) symmetry. (auth)

6184 (LNF-73/16) SIMPLE TEST OF THE TRASVERSALITY HYPOTHESIS IN e^+e^- ANNIHILATION INTO HADRONS. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 3 May 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

Kinematical inequalities are derived for the angular distribution of hadrons produced in e^+e^- collisions: it is found that a $1 + \cos^2\theta$ inclusive distribution implies that all produced particles are coplanar. (auth)

6185 EMISSION OF HARD PHOTONS IN e^+e^- ANNIHILATION INTO HADRONS AT HIGH ENERGIES. Matinyan, S. G.; Pirogov, Yu. F.; Ter-Isaakyan, N. L.; Shakhnazaryan, Yu. G. (Erevan Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 122-123(5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 205-208(5 Aug 1973).

It is shown that at high energies the inclusive process of e^+e^- annihilation into hadrons, accompanied by emission of a hard photon from the lepton, is significant at limited transverse dimensions of the singled-out hadron and dominates over the corresponding process without photon emission. (auth)

6186 FURTHER EXPERIMENTAL TESTS OF A GAUGE-INVARIANT PION-POLE-DOMINATED MODEL FOR THE INCLUSIVE PROCESS $e^-p \to e^-\pi$ + ANYTHING. Muetter, K. H.; Rothe, H. J.; Stamatescu, I. O. (Univ., Heidelberg). Nucl. Phys.; B63: 229-236(1973).

New data on the inclusive electroproduction process $e^- + p \to e^- + \pi$ + anything are analyzed within the framework of a gauge-invariant pion-pole-dominated model. It is found that the model, containing only one free parameter, leads to good agreement with experiment for $x \geq 0.7$, where x is the Feyman variable for the observed pion. (auth)

6187 INFLUENCE OF MULTIPLE SCATTERING ON TRANSITION RADIATION. Alikhanyan, A. I.; Belyakov, E. S.; Garibyan, G. M.; Lorikyan, M. P.; Markaryan, K. Zh.; Shikhlyarov, K. K. JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 18-20(5 Jul 1973).

Translation of Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 35-39(5 Jul 1973).

The results of the measurement of the spectrum of the transition radiation produced when 680-MeV electrons pass through a layered paper radiator are presented. It is shown that multiple scattering of the electrons does not affect the intensity of the transition radiation. (auth)

6188 ACCOUNT OF MULTIPLE SCATTERING AT SCATTERING AND PHOTOPRODUCTION OF PIONS ON DEUTERONS. Senyushkin, V. B. (Leningrad State Univ.). Yadern. Fiz.; 18: No. 3, 524-536(Sep 1973). (In Russian).

Corrections to the πd scattering and the photoproduction $\gamma + d \to \pi^0 + d$ due to the multiple scattering are considered. Equation for the part of the three particle πNN amplitude that takes the pion rescattering into account is solved in the slow-nucleon approximation. Corrections to the differential and total πd scattering and photoproduction cross sections are calculated. An estimate is obtained for correction to the πd scattering cross section due to appearance of an additional internal pion line in the multiple scattering diagrams. (auth)

6189 SPIN-3/2 POLARIZATION DENSITY MATRIX IN THE ELECTROPRODUCTION OF Δ (1236). Song, H.S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 8: No. 3, 820-826 (1 Aug 1973).

The production process $ep \to e\Delta$ is considered assuming one-photon exchange. Our way of parameterizing the spin-3/2 density matrix is compared with the formalism of Doncel, Michel, and Minnaert. From the explicit expression for the process in terms of three form factors, we obtain the hadronic current tensor when Δ is polarized and the density-matrix elements of Δ. It is shown that separate values of three form factors can be obtained explicitly from the differential cross section and density matrix. Further applications of this approach are suggested. (auth)

6190 PAIR PRODUCTION BY PHOTONS: EXACT CALCULATION FOR UNSCREENED ATOMIC FIELD. Øverbø, I.; Mork, K.J.; Olsen, H.A. (Institute of Physics, University of Trondheim, NLHT, Trondheim, Norway). Phys. Rev. A 8: No. 2, 668-685 (Aug 1973).

Exact relativistic Coulomb wave functions, in the form of partial-wave expansions, are used to obtain analytic formulas for the differential cross sections and energy spectrum for electron–positron pair production by photons. Radiative corrections, which are believed to be small (of the order of 1%), are neglected. The errors introduced by the finite nuclear size and recoil effects are quite negligible for the energy region considered here. Apart from these approximations, the present formulas give the exact cross sections for the unscreened atomic field. Numerical results are obtained for positron energy spectra for a large number of photon energies and atomic numbers in the ranges $2m_ec^2 < k \leq$

$10m_ec^2$ and $1 \leq Z \leq 100$. Total cross sections are obtained by numerical integration of the spectra. A representative choice of spectra are given. The approximately 500 total cross sections calculated are given in tables and diagrams. By one- or two-way interpolation in these data the total cross section for any photon energy and nuclear charge within the given limits may be obtained with an accuracy of 1% or better. For heavy elements large Coulomb corrections to the Bethe–Heitler Born–approximation results are found. The positron energy spectra obtained are asymmetric, favoring positrons of high energy. The total cross section σ is smaller than the Bethe–Heitler total cross section σ_B for photon energies very close to the threshold (owing to the repulsion of the positron), while σ is generally larger than σ_B in the energy region $2.2m_ec^2 \lesssim k \lesssim 10m_ec^2$. (auth)

6191 LIGHT-CONE DOMINANCE IN INCLUSIVE e^-e^+ ANNIHILATION. Ellis, J. (California Institute of Technology, Pasadena, California, 91190); Frishman, Y. Phys. Rev. Lett. 31: No. 2, 135-138 (9 July 1973).

It is argued that light-cone dominance ideas are compatible with canonical scaling in the process e^-e^+–hadron+anything and a logarithmic increase in hadronic multiplicity. (auth)

6192 OBSERVATION OF THE A_1 MESON. Kaflev, Yu. N.; Serebryakov, V. V. (Mathematics Inst., Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 109-111(5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 187-189(5 Aug 1973).

The problem of the existence of the A_1 meson and its detection in photo- and electroproduction is investigated. The absence of the A_1 meson in photoproduction is discussed and the cross section of its electroproduction is estimated. (auth)

6193 INVESTIGATION OF THE POLARIZATION PLANE OF PHOTONS AFTER COMPTON SCATTERING BY POLARIZED ELECTRONS. Bock, P.; Luksch, P. (Univ., Karlsruhe, Ger.). Z. Phys.; 263: No. 2, 147-168(1973). (In German).

Two polarization phenomena in Compton scattering by polarized electrons were investigated. In the first experiment, the rotation of the polarization plane of photons passing through magnetized iron and gadolinium was measured. The effect arises from a spin dependence of the Compton forward scattering amplitude. For 228 and 333 keV photons and iron absorbers, the observed rotation angles are $(3.90 \pm 0.57) \times 10^{-3}$ rad $\times$ cm^{-2} and $(4.75 \pm 0.58) \times 10^{-3}$ rad $\times$ cm^{-2}, respectively. Secondly, the orientation of the photon polarization plane after scattering of unpolarized photons by polarized electrons was measured. This experiment tests time reversal invariance in quantum electrodynamics. No dependence of the polarization plane on the direction of the electron spin was found within 2×10^{-3}. (auth)

6194 SOBRANIE NAUCHNYKH TRUDOV. II. Fizika Elementarnykh Chastits. Elektromagnitnye i Slabye Vzaimodeistviya. (Collection of Scientific Proceedings. Volume II. Physics of Elementary Particles. Electromagnetic and Weak Interactions). Pomeranchuk, I. Ya. Moscow; Izdatel'stvo Nauka (1972). 296p.

The scientific works of I. Ya. Pomeranchuk were collected. In the second volume articles on the theory of electromagnetic and weak interactions of elementary particles are compiled. (JSR)

6195 PRODUCTION OF e^+e^--PAIRS FROM THE VACUUM BY THE ELECTRIC FIELD. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Teor. Mat. Fiz.; 17: No. 1, 34-46(Oct 1973). (In Russian).

The problem of pair production of spin ½ particles in the external homogeneous electric field E(t) is considered. The Heisenberg equations of motion for the creation-annihilation operators are written out, the solutions of which have the form of a linear canonical transformation. The system of differential equations for the coefficients U(t), V(t) of this transformation is obtained. Probabilities of the pair production are expressed through the eigenvalues of the matrix VV^+. The case of particles possessing the anomalous magnetic moment is also considered. (auth)

6196 INTERPRETATION OF THE DIRAC RELATIONSHIP BETWEEN FUNDAMENTAL CONSTANTS. Cavallo, G. (Consiglio Nazionale delle Riverche, Bologna). Nature (London); 245: No. 5424, 313-314(12 Oct 1973).

A mathematical discussion is presented on Dirac's finding that the ratio between the age of the universe and the "natural" unit of time, which he took to be the time light takes to cross an electron radius, is approximately equal to the ratio between the electrostatic and the gravitational force acting between two electrons. A semi-empirical relation is presented that it is claimed could throw some light on Dirac's finding. It is proposed that the universe is endowed with angular momentum, although so far there is no observational support for an overall rotation of the universe. Application is made to elementary particles, nuclei, and atoms; planetary and stellar systems; and galactic systems. Consideration is given to a model involving an expanding, rigidly rotating Newtonian universe; and other models are discussed. The effect of substituting another "natural" unit of length in place of the classical radius of the electron, such as the Compton wavelength of the electron or the Bohr radius of the H atom, is also considered. (UK)

6197 COUPLED-CHANNEL MODEL OF $e^+e^- \to \pi^+\pi^-$ AND $e^+e^- \to 2\pi^+ + 2\pi^-$. Kreuzer, H.J.; Kamal, A.N. (Department of Physics and Theoretical Physics Institute, University of Alberta, Edmonton, Alberta, Canada). Phys. Rev. D 8: No. 5, 1431-1434 (1 Sept 1973).

A two-channel model for the electromagnetic form factors is set up to explain the qualitative features of the Frascati data on $e^+e^- \to \pi^+\pi^-$ and $e^+e^- \to 2\pi^+ + 2\pi^-$. Our model shows a significant rising of the tail of the ρ resonances in $|F_\pi(s)|$, explains the enhancement of $\sigma_{4\pi}(s)$ at $2E_{c.m.} \approx 1.5$ GeV as a nonresonant threshold effect due to a $\sigma\sigma$ intermediate state, and predicts a structure in $\sigma_{4\pi}(s)$ in the ρ region. (auth)

6198 BILOCAL CURRENTS AND SCALING IN GENERALIZED BJORKEN LIMITS. Choudhury, D.K. (Department of Theoretical Physics, University of Oxford, 12 Parks Road, Oxford, England); Murtaza, G. Phys. Rev. D 8: No. 5, 1557-1571 (1 Sept 1973).

We investigate the processes $eN \to ehX$, $(\nu,\bar{\nu})N \to \mu hX$ ($h = \pi,\rho,\gamma$), in three different kinematic regions and study the behavior of the relevant integrated structure functions in generalized Bjorken limits. The technique used is a generalization of the bilocal current algebra put forward by Fritzsch and Gell-Mann. As a consequence of the hypothesis of light-cone dominance, we obtain scaling in the Bjorken limits of all the three kinematic regions. We also find that the scaling functions are expressible as a linear combination of those for the ordinary inclusive reactions and that their explicit dependence on the scale parameters is uniquely predicted once the scaling functions for the processes $eN \to eX$ and $(\nu,\bar{\nu})N \to \mu X$ are known. (auth)

6199 COMPARISON OF THE PARTON AND GENERALIZED VECTOR-DOMINANCE ANALYSES OF DEEP-INELASTIC ELECTRON-NUCLEON SCATTERING. Pestieau, J. (Institut de Physique Théorique, Université de Louvain Louvain-la-Neuve, Belgium); Urias, J. Phys. Rev. D 8: No. 5, 1552-1557 (1 Sept 1973).

It is shown that, while generalized vector dominance is strictly applicable in the diffractive limit ($\nu \to \infty$, any $Q^2 \geq 0$ such that $x \equiv Q^2/2M\nu \to 0$) of electron-nucleon scattering and the parton model is applicable in the scaling limit ($Q^2 \to \infty$, x fixed), these two models are identical for describing the deep diffractive limit ($Q^2 \to \infty$ $x \to 0$). This equivalence is then used to interpret the different contributions of vector hadronic states which couple to the photon. A new scaling variable x comes out naturally from our analysis. (auth)

6200 AMPLITUDE STRUCTURE IN PREDOMINANTLY POMERANCHUKON-EXCHANGE REACTIONS AND s-CHANNEL HELICITY NONCONSERVATION. Chadwick, G.; Eisenberg, Y.; Kogan, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 5, 1607-1610 (1 Sept 1973).

The unit-helicity-flip and -nonflip amplitudes of $\gamma p \to \rho^0 p$ and $\pi N \to \pi N$ for $I = 0$ exchange are shown to be similar in magnitude when scaled by the vector-dominance-model constant. We separate the ρ^0 amplitudes for Pomeranchukon and f exchange using the dual absorption model. Possible sources of the helicity-flip term are discussed. (auth)

6201 CORRESPONDENCE ARGUMENTS FOR HIGH-ENERGY COLLISIONS. Bjorken, J.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Kogut, J. Phys. Rev. D 8: No. 5, 1341-1357 (1 Sept 1973).

We assume that in deep-inelastic processes such as $e^-p \to e^- +$ hadrons, $\nu_\mu p \to \mu^- +$ hadrons, $e^+e^- \to$ hadrons, or $pp \to$ hadrons of high transverse momentum, the dynamics is continuously and smoothly connected to their limiting cases. For example, the process $\gamma p \to$ hadrons is a limit of $e^-p \to e^- +$ hadrons, exclusive channels are limiting cases of inclusive spectra, and $pp \to$ low-p_T hadrons is a limiting case of $pp \to$ high-p_T hadrons. The demand that these limits be smooth we call correspondence (with apologies to Bohr). Correspondence evidently is closely related to the concept of duality, although much cruder at least in the way we practice it. We first apply the correspondence method to some familiar examples. However, the main applications are to the processes $e^-p \to e^- +$ hadrons, $\nu p \to \mu^- +$ hadrons, and $e^+e^- \to$ hadrons. We find find several properties of hadron inclusive distributions and exclusive channels to be roughly independent of Q^2, in particular (a) the scaled inclusive momentum distribution in colliding-beam processes, (b) hadron inclusive distributions (and therefore multiplicity) at a given s in electroproduction, (c) the ratio of nondiffractive exclusive electroproduction cross sections (such as $e^-p \to e^-\pi^+n$) to total electroproduction cross sections at fixed s, and (d) the ratio of the cross section for coherent electroproduction of all vector states to the total electroproduction cross section. Some semiquantitative estimates are given. (auth)

6202 PION MASS AND THE CABIBBO ANGLE. Chkareuli, J. L.; Paziashvili, I. V. (Inst. of Physics, Tbilisi, USSR). Phys. Lett., 47B: No. 1, 43-46(15 Oct 1973).

The relation between the Cabibbo angle and the pion mass is analyzed in the framework of the Glashow–Weinberg type theory with explicit SU(2) and strangeness breakings, in which the strangeness conservation limit corresponds to massless pions (without any restrictions on the intraisotopic mass splittings of mesons). In this way $\sin^2\theta \simeq (\pi^+F_{\pi^+}/K^0F_{K^0})\ (Z_{\pi^+}/Z_{K^0})^{-\frac{1}{2}}$ is found in good agreement with the experimental value for $Z_\pi = Z_K$. (auth)

6203 SOLUTION OF THE DIRAC EQUATION WITH TWO COULOMB CENTRES. Mueller, B.; Rafelski, J.; Greiner, W. (Univ., Frankfurt am Main). Phys. Lett., 47B: No. 1, 5-7 (15 Oct 1973).

The Dirac equation for a relativistic particle (electron) in the field of two Coulomb centres Z_1 and Z_2–pointlike as well as extended charges–has been solved. The systems Br-Br, I-Au, U-U are shown as examples. (auth)

6204 PRECOCITY OF SCALING IN DEEP INELASTIC ELECTRON PROTON SCATTERING. Gorczyca, B.; Schildknect, D. (DESY, Hamburg). Phys. Lett.; 47B: No. 1, 71-74 (15 Oct 1973).

It is quantitatively shown that precocity of scaling is largely due to the contribution of the low lying vector mesons to the virtual forward Compton scattering amplitude. (auth)

6205 HIGH ENERGY BEHAVIOR OF TOTAL CROSS SECTIONS FOR e^+e^- SCATTERING AND THE SLOPE AT $q^2 = 0$ OF THE DIRAC FORM FACTOR. Kuraev, E. A.; Lipatov, L. N.; Merenkov, N. P. Phys. Lett., 47B: No. 1, 33-35(15 Oct 1973).

The slope at $q^2 = 0$ of the fourth order Dirac form factor is expressed in terms of various exclusive high energy cross sections for e^+e^- scattering. The agreement between high energy and low energy calculations is obtained. (auth)

6206 PION FORM FACTOR IN THE PARTON MODEL. Ravndal, F. (California Inst. of Tech., Pasadena). Phys. Lett., 47B: No. 1, 67-70(15 Oct 1973).

A photon interacting with a spin 0 pion will in the parton model couple to its spin ½ constituents. This has important implications for the elastic and transition form factors of the pion. Experimental consequences are discussed. (auth)

6207 ASYMPTOTIC SUM RULES. Lazarenko, L. A.; Soroka, V. A. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 7, 1218-1220(Jul 1973). (In Russian).

New relations between elastic and inelastic form factors for electrons are discussed. (tr-auth)

6208 LIMITING FRAGMENTATION AND PULVERIZATION IN BILOCAL CURRENT ALGEBRA. Choudhury, D. K. (Dept. of Theoretical Physics, Oxford). Phys. Lett., 47B: No. 1, 63-66(15 Oct 1973).

Predictions are made for the limiting behavior of the single particle distribution $(E/\sigma^T)\ (d^3\sigma/d^3p)$ and the average multiplicity $\langle n \rangle$ for the deep inelastic semi-inclusive processes $ep \to ehx$ and $(\nu,\bar{\nu})\ p \to \mu hx$ where h is a pseudoscalar or vector meson. Technique used is a generalization of free quark bilocal algebra and the assumption is its validity in the entire longitudinal phase space of h. The analysis shows that the single particle distribution in the fragmentation regions scales as a function of Bjorken variable ω and the Feynman variable $x = 2p_{\|}/\sqrt{s}$. It also suggests that the production mechanism in the central region is not related to pionization in purely hadronic collisions, but rather to "pulverization" proposed by Chou and Yang. (auth)

6209 SOME CONSEQUENCES OF THE QUARK PARTON MODEL IN INCLUSIVE ELECTROPRODUCTION. Hasenfratz, P. (Central Research Inst. for Physics, Budapest). Phys. Lett., 47B: No. 1, 60-62(15 Oct 1973).

Consequences of the quark parton model proposed by Feynman for inclusive electroproduction are studied. It is shown that the SLAC experiment $\gamma_v + p(n) \to h^\pm +$ anything which distinguishes the outcoming hadrons by their charges only gives the possibility to check sum rules with fractional quark quantum numbers, to determine the charge of the proton quark (neutron quark) and to measure the valence quark distribution functions directly. The multiplicity difference for the charged hadrons is predicted as the function of q^2, which agrees well with the experimental data published recently. (auth)

6210 DETERMINATION OF RESONANCE COUPLINGS IN SINGLE PION PHOTOPRODUCTION USING FIXED-t DISPERSION RELATIONS. Devenish, R. C. E. (Univ. Coll., London); Rankin, W. A.; Lyth, D. H. Phys. Lett., 47B: No. 1, 53-59(15 Oct 1973).

Fits to around 3000 data points with 37 parameters (χ^2/data point 8–10) and 68 parameters (χ^2/data point 3–5) include all known resonances with mass ≤ 1.8 GeV. Values and errors are given for all couplings, some of them being well determined for the first time. Only the couplings of the P11 (1434) definitely disagree in sign with the (unmixed-state) quark model. (auth)

Weak

6211 NEUTRAL CURRENTS AND P-ODD EFFECTS IN DEEP INELASTIC MUON SCATTERING. Nikolaev, N. N.; Shifman, M. A.; Shmatikov, M. Zh. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 39-42(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 70-73(5 Jul 1973).

The possibility of observing the neutral-current interactions predicted by weak-interaction gauge models, using P-odd effects in deep inelastic scattering of polarized muons is discussed. (auth)

6212 NONLEPTONIC INTERACTION AND ITS CONSEQUENCES IN A RENORMALIZABLE THEORY OF WEAK INTERACTIONS. Gupta, V. (Tata Institute of Fundamental Research, Colaba, Bombay-5, India). Phys. Rev. D 8: No. 5, 1516-1518 (1 Sept 1973).

The nonleptonic interaction and its consequences in a particular renormalizable theory of weak interactions mediated by spin-zero bosons are discussed. It is pointed out that the $\Delta S = 0$ weak nuclear processes and the deviations from octet dominance in the $\Delta S = 1$ nonleptonic decays $B \to B' + \pi$ can serve to distinguish it from the usual V – A theory. (auth)

6213 OFF-MASS-SHELL PARITY-VIOLATING PION-NUCLEON INTERACTION. Henley, E.M.; Keliher, T.E. (Physics Department, University of Washington, Seattle, Washington 98195); Pardee, W.J.; Yu, D.U.L. Phys. Rev. D 8: No. 5, 1503-1515 (1 Sept 1973).

In the usual theoretical description of parity violation, off-mass-shell effects of the weak pion–nucleon interaction are neglected. In the Cabibbo theory, the weak parity-violating pion–nucleon vertex is then proportional to $\sin^2\theta \simeq 0.05$ as it arises only from strangeness-changing weak currents. If off-mass-shell effects are taken into account, then a vertex proportional to $\cos^2\theta$ is possible. In this work, we derive an effective $\cos^2\theta$ pion-nucleon interaction by means of the renormalizable σ model. We obtain an effective dimensionless coupling estimate which is roughly given by $Gg\bar{\sigma}x\,\phi\,\Delta M/M$ if the nucleon is timelike and half off its mass shell by ΔM. Thus neutral as well as charged weak pion–nucleon couplings of sizable strengths ($\approx 10^{-6}$) are predicted by this model even though no neutral weak currents are invoked. (auth)

6214 SOME CONSEQUENCES OF AN SU(2) ⊗U(1) GAUGE MODEL. Beg, M.A.B.; Zee, A. (Department of Physics, The Rockefeller University, New York, New York 10021). Phys. Rev. D 8; No. 5, 1460-1466 (1 Sept 1973).

The experimental consequences of an SU(2) ⊗U(1) model in which the intermediate-boson mass m_W is bounded below by 13 GeV are discussed. For the special choice of $m_W = 18$ GeV neutral-current effects essentially disappear. The model includes a heavy neutral lepton of the muon type whose mass is bounded above and below by ≈ 1.2 GeV and 390 MeV, respectively. The model is thus relatively more accessible to experimental tests than other gauge models. Other aspects of the model are discussed. (auth)

6215 SEMIMONOTONIC BOUNDS FOR K_{l3} SCALAR FORM FACTOR. Okubo, S.; Ueda, Y. (Institute of Theoretical Physics, Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 8: No. 5, 1372-1382 (1 Sept 1973).

On the basis of analyticity and the soft-pion theorem, various exact bounds for the scalar K_{l3} form factor D(t) have been obtained, assuming that D(t) satisfies at most a once-subtracted dispersion relation, and that ImD(t + i0) can change its sign at most only once on the cut. These bounds do not contain any arbitrary free parameters. Neither do we use any explicit Hamiltonian nor any approximation such as the pole-dominance model for its derivation. The results obtained disagree with the present experiment. A connection of this method with the phase representation of D(t) is also discussed, and we find that under some simple conditions, the result is at variance with present experiment. (auth)

6216 EFFECTS OF THE NEUTRAL WEAK CURRENT ON THE PROCESS $\nu + (Z) \to \nu + \mu + \bar{\mu} + (Z)$. Fujikawa, K. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 8: No. 5, 1623-1626 (1 Sept 1973).

The effects of the neutral weak current of the spectra of charged leptons in the process $\nu + (Z) \to \nu + \mu + \bar{\mu} + (Z)$ are discussed. We show that the effects of the neutral current can be expressed in

terms of various distributions based on the purely V–A interaction. (auth)

Strong (General)

6217 (COO-1112-141) IMPLICATIONS OF EXPERIMENTAL DATA FOR OUR VIEW OF THE POMERON. Kane, G. L. (Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). 1973. 36p. (UM-HE-73-10). Dep. NTIS $4.00.

A review is given to summarize what can be currently learned about high energy elastic scattering (the Pomeron) by studying the implications of the experimental data. This includes not only the direct analysis of the data, but restrictions which the existing data or future data can put on theoretical ideas even when some theoretical intervention is required. (LBS)

6218 (FRNC-TH-311) APPLICATIONS OF REGGE POLES. Plaut, G. (Nice Univ., 06 (France)). 1972. 88p. (In French). NTIS (U. S. Sales Only).

Three problems connected in different ways to the Regge pole concept are considered: the problem of the choice of the frame of reference in applications of the vector dominance model, tests on the relative phases of the helicity amplitudes in the associated production reactions, and the problem of helicity conservation in the diffractive production of A_1. In the case of the choice of the frame of reference, the Regge trajectory exchange models furnished useful information and enabled the plausibility of the solution proposed with a correct treatment of the kinematic mass dependent singularities to be verified. The tests proposed concerning the relative phases of the helicity amplitudes in the associated production reactions do not require the use of polarized targets nor the observation of parity violating decays. The concept behind these tests can be deduced from the Donohue relations for the production of baryon resonances in a pure state. The tests consist of calculating a certain number of quadratic terms concerning the angular distributions associated with the decay products of the two resonances. The utilization of the double Regge model for studying diffractive resonances favors the conservation of helicity of the s channel in the production of A_1. (FR)

6219 (RL-73-61) MULTIPARTICLE HADRON DYNAMICS: A PERSONAL VIEW. Hong-Mo, C. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jul 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

A review is given of current hadronic models for particle production. (JFP)

6220 (RL-73-95) PHENOMENOLOGY OF INCLUSIVE REACTIONS. Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 134p. Dep. NTIS (U. S. Sales Only) $8.75.

It is stated that the study of strong interactions recently has been dominated by multiparticle production and the attempts to learn the dynamics which govern the cross sections, multiplicities, correlations, etc., of such processes. Our understanding of the behavior of total cross sections comes almost entirely from using the optical theorem to translate the study to that of elastic scattering amplitudes. The systematic behavior of these, in turn, can be largely explained by Regge theory and duality. The content of the lectures is mainly a generalization of this approach to inclusive reactions. The sectional headings are: kinematics and definitions; Mueller's optical theorem; duality; fragmentation region phenomenology; central region phenomenology; triple Regge behavior; finite mass sum rules; applications of FMSR; semi-local duality for Reggeon-particle scattering; diffraction (Pomeron-particle total cross section, Pomeron-particle elastic scattering); correlations. (UK)

6221 (RL-73-111) STRUCTURE OF TWO-BODY CORRELATIONS IN HIGH-ENERGY HADRON PRODUCTION. Le Bellac, M.; Miettinen, H. I.; Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Experimental information on diffraction is used to estimate long-range effects in multiparticle production. Diffractively produced secondaries are found to produce a plateau in the central region. Diffraction accounts for 30% of the observed correlations and the remainder, consistent with being short range, corresponds to a cluster size of 2.4 charged particles. (auth)

6222 (TID-26480) MODEL INDEPENDENT FEATURES OF DIFFRACTION. Halzen, W. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1973. 32p. Dep. NTIS $3.75.

High energy diffraction of hadrons is discussed on the basis of results that can be derived from axiomatic field theory and results that can be derived from data. Emphasis is placed on elastic scattering; particle production and its relation to elastic scattering are discussed in the framework of s-channel unitarity. (LBS)

6223 PROOF OF THE POMERANCHUK THEOREM FOR UNBOUNDED TOTAL CROSS SECTIONS. Grunberg, G.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, 75 Paris V, France). Phys. Rev. Lett. 31: No. 1, 63-66 (2 July 1973).

If particle or antiparticle total cross sections σ_P, σ_A are unbounded as $E \to \infty$, using unitarity it is shown that on the average the ratio $<\sigma_P-\sigma_A>/<\sigma_A+\sigma_A> \to 0$. (auth)

6224 TRANSVERSE-MOMENTUM LIMITATION IN THE ONE-DIMENSIONAL GAS MODEL. Stodolsky, L. (Max-Planck-Institut für Physik und Astrophysik, Munich, Germany). Phys. Rev. Lett. 31: No. 2, 139-141 (9 July 1973).

A strict application of the assumptions of the pion rapidity-gas model of multiproduction, together with simple kinematics, imply a connection between the coupling strength C and the average transverse mass $\bar{\mu}_T$, which is $C \lesssim M/\bar{\mu}_T$, with M a typical leading particle mass. The most important consequence is that if C is large, as it is experimentally, $\bar{\mu}_T$ must be small, and thus a strong transverse-momentum limitation need not be introduced as a separate assumption. Furthermore C is limited to order 1 (which incidentally means that there must be a critical coupling constant in the multiperipheral model). Experimentally C appears to be near its maximal value. We indicate that there is a kind of model in which this arises automatically. (auth)

6225 V–N SECTOR OF THE LEE MODEL. Sen, S. (Trinity Coll., Dublin). Int. J. Theor. Phys.; 8: No. 2, 147-153 (1973).

The V–N sector of a modified Lee model is solved by dispersion theory techniques. The method of solution clearly indicates the importance of asymptotic conditions in solving bound-state problems. (auth)

6226 TOTAL-ABSORPTION MODEL OF HIGH ENERGY SCATTERING. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 8: No. 9, 563-568 (27 Oct 1973).

A model of high energy hadron–hadron scattering is considered where each hadron is a fully absorbing scatterer with a radius that increases with energy. The energy dependence of the radius is chosen such that the total cross section has the energy behavior of the Froissart bound. The scattering of two equal-mass spinless, isoscalar, nonidentical particles and the case of identical particles are considered. The scattering amplitudes and differential and total cross sections peak are found. (JFP)

6227 DUAL RESONANCE THEORY. Schwarz, J. H. (California Inst. of Tech., Pasadena). Phys. Rep.; 8C: No. 4, 269-335 (Sep 1973).

It is suggested that a dual model could provide a Born Approximation to a complete theory of hadrons. After reviewing various properties of Veneziano model amplitudes, including their underlying algebraic structure, more recent developments are discussed. The spectrum generating algebra is constructed and used to prove the no-ghost theorem for space-time dimension $d \leq 26$. A modification of the Veneziano model incorporating SU(N) symmetry in a dynamical fashion is shown to have critical dimension 26–N. A detailed discussion of the dual pion model and its extension to fermions is presented. It is proved that both the meson and fermion sectors are ghost free for $d \leq 10$. Finally, there is a discussion of nonplanar models and their possible connection with the pomeron singularities arising from nonplanar loop diagrams. (auth)

6228 QUARKS FOR PEDESTRIANS. Lipkin, H. J. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Rep.; 8C: No. 3, 173-268 (Aug 1973).

The discussion covers the hadron spectrum in the quark model, algebraic structure of the quark model, algebraic analysis of quark model predictions, and the algebraic structure of the quark parton model. (JFP)

6229 SOBRANIE NAUCHNYKH TRUDOV. III. Fizika Elementarnykh Chastits. Silbnye Vzaimodeistviya. (Collection of Scientific Proceedings. Volume III. Physics of Elementary Particles. Strong Interactions). Pomeranchuk, I. Ya. Moscow; Izdatel'stvo Nauka (1972). 420p.

The scientific works of I. Ya Pomeranchuk were collected. In the third volume particles on the theory of strong interactions of elementary particles are compiled. (JSR)

6230 ASPECTS OF THE REGGE–MUELLER MODEL OF INCLUSIVE REACTIONS. Freeman, J. R. Stony Brook, NY; State Microfilms Order No. 73-27,012.

Thesis (Ph. D.).

High energy multiparticle production is investigated using the Regge-Mueller model of inclusive reactions. By introducing finite thresholds for Regge behavior in the various channels of Mueller graphs, inclusive spectra are described everywhere in

the accessible phase space by Reggeized Mueller graphs. A connection is predicted between the shape (i.e., curvature) of the limiting single particle spectrum and the direction of approach to this limiting shape. Analogous predictions are made for two particle spectra. Conservation sum rules for single particle spectra are examined. Criteria for weak energy dependence of single particle spectra in various kinematic regions are investigated. A rapid scaling criterion in the central region is suggested based on an analysis of measured pion single particle spectra. The resulting degeneracy constraints among Regge residues are used to predict the behaviour of (i) pion and kaon single particle spectra in the central region; (ii) two particle inclusive spectra and two particle correlations. Some questionable approximations in the Regge-Mueller model for two particle correlations are examined. Three particle correlations are briefly considered in the context of a generalized pattern of duality criteria for Regge-Mueller graphs. A Reggeized single particle spectrum is developed when one of the incident projectiles is a space-like or time-like photon. (auth)

6231 CUTS IN THE ANGULAR MOMENTUM PLANE AND INCLUSIVE-TYPE SUM RULES. Kang, K. (Division de Physique Théorique, Institut de Physique Nucléaire, Laboratoire de Physique Théorique et Hautes Energies, Paris, France); Moore, R.W.; Nicolescu, B. Phys. Rev. D 8: No. 5, 1533-1536 (1 Sept 1973).

Explicit forms for the two-Reggeon cut in particle-particle scattering are derived from the sum rule for inclusive-type discontinuities in the kinematic region near the phase-space boundary. When the dual resonance model is used as a representation for the six-point amplitude, the detailed results are in agreement with those of Abarbanel. (auth)

6232 UNITARITY CONSTRAINTS ON MOMENTS OF INCLUSIVE CROSS SECTIONS. Webber, B.R. (Cavendish Laboratory, Cambridge, England). Phys. Rev. D 8: No. 5, 1615-1618 (1 Sept 1973).

It is shown that various moments of inclusive cross sections, such as the average transverse momentum, must satisfy rigorous inequality constraints involving the slope of the diffraction peak. (auth)

6233 TRANSVERSE MOMENTA AND OVERLAP FUNCTIONS IN MULTIPERIPHERAL MODELS. Hamer, C.J.; Peierls, R.F. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 8: No. 5, 1358-1371 (1 Sept 1973).

The multi-Regge model is studied, with particular emphasis on the predicted slope of the elastic diffraction peak, and the average transverse momentum of the produced particles. The slope of the diffraction peak is proportional to the mean-square impact parameter, and in the multi-Regge model the total impact parameter is built up in a random walk, with each link in the multiperipheral chain corresponding to a step in the walk. A simple Chew-Pignotti model is incapable of fitting the inclusive production data at high energies: It predicts too slow an increase in the multiplicity of produced pions, and too rapid a shrinkage of the diffraction peak. To cure this problem, one must introduce "clustering" effects such as to reduce the over-all spread in impact parameter, and increase the density of produced pions in longitudinal-momentum space. Such effects were to be expected, in fact, because of resonance formation. A multiperipheral cluster model is introduced, in which the decay of the clusters is described via the statistical bootstrap model of Hagedorn and Frautschi. A crude fit to the high-energy data, in which all the clusters are given a common mass, shows that the average cluster mass is at least a couple of GeV, a surprisingly large figure. This provides some a posteriori justification for Hagedorn's thermodynamic model. The calculations are carried out using both approximate analytical methods and a Monte Carlo numerical program. (auth)

6234 A STATISTICAL MEASURE OF CLUSTERING IN MULTIPARTICLE FINAL STATES. Ludlam, T.; Slansky, R. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 8: No. 5, 1408-1422 (1 Sept 1973).

A quantitative measure of clustering effects in many-particle final states is defined and its significance discussed. The results consist of a single curve and a number, $\langle\omega_n^2\rangle$, which may be extracted from inclusive or exclusive data where the longitudinal momenta (or some other variable) have been measured for n particles in each event. The curve is a measure of the average fluctuation of each event away from the over-all distribution, and is defined strictly in terms of experimental quantities. The results appear to provide a sensitive test for models of hadron production. Comparison with Monte Carlo calculations, or with a statistical reference model which is described, allow one to interpret the results in a fairly model-independent manner. The analysis is then applied to some 13-GeV/c K^- p data. (auth)

6235 GENTLE FRAGMENTATION OF HADRONS. Lai, C.S. (Department of Physics, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada); Lo, S.Y.; Noble, D. Phys. Rev. D 8: No. 5, 1598-1602 (1 Sept 1973).

Gentle fragmentation implies (i) peaks and not dips at transverse momentum $p_\perp = 0$ for all allowed diffractive processes, (ii) a hierarchy of diffractive scatterings, and (iii) suppression of massive excitation and final states with high multiplicity. An experimental plot is shown to test the hypothesis of gentle fragmentation conclusively. (auth)

6236 SLOPE OF THE FORWARD PEAK: An s-CHANNEL ANALYSIS. Hwa, R.C. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 8: No. 5, 1331-1340 (1 Sept 1973).

Starting from the exact multiparticle unitarity relation, we derive the derivative extension of the optical theorem. The slope of the forward peak is then related in a model-independent way to the rotational properties of production amplitudes. A sequential representation is developed for treating an n-particle state. The formalism is then applied to the multiperipheral and diffractive models. The analysis makes clear the mechanisms in which forward slope is built up in those models. In the case of the multiperipheral model the slope is proportional to the number of links in the multiperipheral chain. Quantitatively, the slope of the Pomeranchuk trajectory at t=0 is too large. In an oversimplified version of the diffractive model, the predicted slope of the elastic forward peak is one-half the mean slope, the average being taken over all two-cluster production processes; consequently, it is too small. The realistic high-energy model is somewhere between the two extremes considered. (auth)

6237 HADRONIC SCALING IN THE SCATTERING OF COMPOSITE SYSTEMS. Fishbane, P.M. (Physics Department, University of Virginia, Charlottesville, Virginia 22901); Trefil, J.S. Phys. Rev. D 8: No. 5, 1467-1485 (1 Sept 1973).

We discuss the problem of limiting behavior (scaling) in the inclusive scattering from composite systems when the inclusive scattering of their constituents is known to scale. In particular, the composite system we study is the nucleus, and the scattering formalism is a multiparticle form of the Glauber theory. The effects we study come from inelastic collisions of independent products of earlier inelastic collisions within a given nucleus, i.e., intranuclear cascading. At sufficiently high energies the distribution from nuclear scattering scales; the scaling function is very closely related to the scaling function for scattering from nucleons. The approach to scaling depends logarithmically on s but also on scattering properties of the constituent nucleons and on properties of the composite nucleus. When these factors are combined we are presented with a rather rich picture of the approach to the scaling limit. We present numerical calculations to illuminate this picture, and discuss possible experimental tests which can be performed with nuclear targets. We speculate on the application of our ideas to hadronic systems themselves and on the features of hadronic systems they may explain. (auth)

6238 MUELLER-REGGE PHENOMENOLOGY IN THE CENTRAL REGION. Freeman, J. R. (State Univ. of New York, Stony Brook); Quigg, C. Phys. Lett., 47B; No. 1, 39-42(15 Oct 1973).

By performing a Mueller-Regge analysis of inclusive pion spectra in the central region (a) the factorization of secondary trajectories in the double-Regge limit is approximately verified; (b) exchange degenerate $P\rho$ and Pf central couplings are found which (c) suggest the absence of short-range correlations between doubly charged pairs of pions. From the fitted central couplings (d) the magnitude of short-range $\pi^+\pi^-$ correlations is estimated and rough agreement is found with preliminary data. (auth)

6239 GENERALIZATION OF THE WATSON THEOREM. Lukaszuk, L. (Institut de Physique Nucleaire, Paris). Phys. Lett., 47B; No. 1, 51-52(15 Oct 1973).

It is proved that the difference between the phase of a form factor and the phase shift of the relevant partial scattering amplitude is bounded in terms of inelasticity. (auth)

Strong (Baryon No. = 0)

6240 (DNPL/R-30, pp 65-76) NUCLEON-NUCLEON CHARGE EXCHANGE SCATTERING. Winbow, G. A. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

Data on differential cross sections for np CEX, $\bar{p}$pCEX, np CEX polarization and for $\bar{p}$p CEX polarization are considered. An attempt is made to interpret the data in complex angular momentum theory. Although it is considered that the simplest Reggeized absorption model is probably wrong in detail it is sufficiently realistic to illustrate how Regge cut models in general can deal with the data. A detailed analysis is given of the spike region. Finally, since experiments have now shown that the spike persists more or less unchanged in np CEX from 0.6 to 29 GeV/c the question is asked, within cut models, where one can expect the spike to be modified. (UK)

6241 (DNPL/R-30, pp 77-122) $\pi\pi$ PHASE SHIFTS FROM $\pi^-p \to \pi^-\pi^+n$ DATA. Martin, A. D.; Estabrooks, P. (CERN, Geneva). 1973.

From proceedings of the pion exchange meeting; Daresbury, Eng. (23 Mar 1973).

It was originally proposed by Goebel (Phys. Rev. Lett.; 1: 337 (1958)) and by Chew and Low (Phys. Rev.; 113: 1640 (1959)) that the $\pi N \to \pi\pi N$ cross section suitably extrapolated from the physical region to the π exchange pole ($t = \mu^2$) would provide a valuable means of determining the $\pi\pi$ differential cross section. Many attempts to extract $\pi\pi$ phases have been based on Chew-Low extrapolations, until now agreement has been reached on the general picture of the phases in the ρ region. However, with the recent increase in experimental statistics of the $\pi^-p \to \pi^-\pi^+n$ data one is confronted with the problem of finding the best way to account for the other exchange mechanisms which are seen to occur in addition to π exchange. The method that is proposed is to use the observed moments of the $\pi^-\pi^+$ angular distribution to perform an amplitude analysis of the production process. In this way the dominant π exchange amplitudes can be isolated and extrapolated to the π exchange pole. That such an amplitude analysis can be performed without knowledge of the nucleon polarization observables is a fortunate circumstance of the nature of the exchanges. (UK)

6242 (JINR-E2-7221) ANALYSIS OF THE $\pi\pi$ SCATTERING δ_0^0 UNCERTAINTY BY THE DISPERSION RELATION METHOD. Goloskokov, S. V.; Shirkov, D. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

The $\delta_{m_\pi}^{4m_\pi}$ uncertainty is analysed by means of dispersion relations for forward scattering. It is shown that the solutions without resonance in the vicinity of M_ρ are essentially favoured. The ambiguity of δ_0^0 around 1 GeV/c can not be removed by using currently available experimental data. (auth)

6243 CORRECTIONS TO WEINBERG'S PION–PION SCATTERING LENGTHS. Grassberger, P. (Univ., Bonn). Z. Phys.; 264: No. 3, 241-252(1973).

We derive twice subtracted dispersion sum rules for the $\pi\pi$ scattering lengths. The subtraction constants are the Weinberg values, and the dispersion integrals yield small corrections in good agreement with other authors. (auth)

6244 BROKEN CHIRAL DYNAMICS. Tsao, H. S. Stony Brook, NY; State Univ. of New York (1972). 140p. University Microfilms Order No. 73-15,905.

Thesis (Ph. D.).

Firstly, the low energy limit of the $\pi\pi$ and πN amplitude in the SU(2) × SU(2) σ-model is investigated up to the one loop approximation. For the πN amplitude, new nonanalytic terms of the form $(\sqrt{\epsilon})^{2n+1}$ are found, in addition to $\epsilon^n \ln\epsilon$ in the individual diagrams. However, in the total contribution to both the $\pi\pi$ and πN full amplitudes, the nonanalytic contributions only appear in order of $\xi^3 \ln\xi^2$ and $\xi^2\sqrt{\epsilon}$. It is concluded that, for the S-matrix the phenomenological Lagrangian does give the correct low energy limit. Secondly, the renormalization of the truncated σ-model up to the two loop approximation is explicitly demonstrated by using the counter terms in the symmetric model. After renormalizing the axial vector current-pion vertex function, it is proved that PCAC condition and Goldstone theorem are satisfied in this order. Finally, the Kl_4 form factors are calculated by using the effective broken chiral SU(3) × SU(3) Lagrangian of Nieh and Tsao together with the effective anomalous chiral SU(3) × SU(3) Lagrangian of Zumino and Wess. The results for the form factors for the process $K^+ \to \pi^+\pi^-e^+\nu$ are $F_1 = 3.20$, $F_2 = -3.74$, $F_3 = -5.68$, and $F_4 = -2.88$, which are in agreement with the recent experimental result. (auth) (Diss. Abstr. Int., B)

6245 LINEAR REGGE TRAJECTORIES, RESONANCE WIDTHS, AND UNITARITY. Dolgov, A. D.; Zakharov, V. I. (Inst of Theoretical and Experimental Physics, Moscow). Lett. Nuovo Cim.; 8: No. 9, 575-578(27 Oct 1973).

It is found that the unitarity condition does not rule out the possibility of strictly linear trajectories in the case of massless pions. The series of relations between intercepts, properties of residues, and branch point arises, however. A comparison of experimental and theoretical values of the widths of the resonances for the ρ and K* trajectories is given for the $\rho(768)$, $g(1680)$, $\rho(2290)$, $4\pi(2675)$, NN(3035), K(890), K(1760), and K(2200). (JFP)

6246 $\rho\pi\pi$ REGGE RESIDUE FUNCTION FROM A NEW CLASS OF SUM RULES, AND A NEW REPRESENTATION FOR $\pi\pi$ AMPLITUDES. Tryon, E.P. (Department of Physics and Astronomy, Hunter College of the City University of New York, New York, New York 10021). Phys. Rev. D 8: No. 5, 1586-1597 (1 Sept 1973).

A new class of sum rules is developed within the context of the $\pi\pi$ system. One of these sum rules is used to extract the $\rho\pi\pi$ Regge residue function from the recent $\pi\pi$ data of Carroll et al., for a wide range of momentum transfer. The residue has a zero near $t = -0.5$ GeV^2, in agreement with duality and with a new prediction which we make from the dual absorption model together with πp and $\bar{p}p$ data. The $\pi\pi$ charge-exchange amplitude is shown to be dominated by ρ exchange above 1.0 GeV. We also derive a new representation which expresses $\pi\pi$ amplitudes in terms of a single subtraction parameter and integrals over physical-region absorptive parts. The representation is valid over a substantial portion of the physical region, and constitutes a powerful tool for studying the $\pi\pi$ interaction. Finally, we show that a unitarized Veneziano model proposed earlier by the present author is an excellent approximation to Nature below about 800 MeV, despite its neglect of Pomeranchon exchange and $K\bar{K}$ production. (auth)

6247 SELF-CONSISTENT LINEARLY RISING ρ REGGE TRAJECTORY. Antippa, A.F. (Département de Physique, Université du Québec, Trois-Rivières, Québec, Canada); Everett, A.E. Phys. Rev. D 8: No. 5, 1446-1460 (1 Sept 1973).

A bootstrap calculation of a linearly rising ρ Regge trajectory is performed using the Balázs method of decoupling the N/D equations, with the left-hand cut approximated by 7 poles. The input ρ mass and width are taken as the experimental values of 750 MeV and 100 MeV, respectively. The value of the bootstrapped slope is 0.701 GeV^{-2} corresponding to an input intercept of $[\alpha_\rho(0)]_{in} = 0.605$, an output intercept of $[\alpha_\rho(0)]_{out} = 0.608$, an output ρ mass of $(m_\rho)_{out} = 747$ MeV, and an output ρ width of $(\Delta m_\rho)_{out} = 71$ MeV. The sensitivity of the results to the details of the calculation is studied extensively. The details of the Balázs method are given as well as some techniques of handling the method in an approximation with a large number of poles. (auth)

6248 MODEL OF PION EXCITATION. Golowich, E.; Holstein, B.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. D 8: No. 5, 1486-1498 (1 Sept 1973).

We study the vector and axial-vector excitation of a pion to an arbitrary single-particle state. The main inputs to our calculation are a hard-pion representation for the relevant off-shell matrix elements, and use of partial conservation of axial-vector current, the Bjorken-Johnson-Low theorem, and current algebra as constraints. We find that for a model incorporating a finite number of poles, the pion cannot be excited to arbitrarily high-spin states. In a particular model we find a cutoff of $J = 4$, and also obtain predictions involving branching ratios for the decay of f(1268) and g(1680) mesons into $A_1(1070)$ π and $\pi\pi$ composites. The results of our model are checked by comparing with sum rules based on local commutation relations. (auth)

6249 WHAT CAN WE MEASURE IN $\rho-\omega$ INTERFERENCE EXPERIMENTS. Rabl, A.; Reay, N. W. (Ohio State Univ., Columbus). Phys. Lett., 47B: No. 1, 29-32(15 Oct 1973).

It is shown that $\rho-\omega$ interference, if studied in pionic production of both 2π and 3π final states, may allow an experimental separation of the phase of the mixing parameter from the phase difference of the ρ and ω production amplitudes. It is pointed out that the mixing parameter measured in 2π final states differs from the one measured in 3π final states, unless certain isospin breaking amplitudes are sufficiently small. (auth)

6250 EXISTENCE AND MAIN PROPERTIES OF THE ρ' (1250)-MESON. Bramon, A. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 8: No. 10, 659-663(3 Nov 1973).

Additional support for the existence of the $\rho'(1250)$ with the properties quoted may also be obtained from a previous model. It is shown there that the extension of vector-meson dominance by simply including a higher mass 1^- nonet provides, with the help of the naive quark model, a satisfactory description of all the known decay rates of the pseudoscalar and vector mesons. The pion form factor from $e^+e^- \to \pi^+\pi^-$ annihilation is found. (JFP)

Strong (Baryon No. = 1)

Refer also to abstracts 6155 and 6160.

6251 (BNL-18152) SU(3)-SYMMETRIC DUEL MODEL FOR MESON–BARYON SCATTERING BASED ON CROSSING INVARIANCE. Igi, K. (Brookhaven National Lab., Upton, N.Y. (USA); Tokyo Univ. (Japan). Dept. of Physics). Aug 1973. 15p. (CONF-730731-2). Dep. NTIS $3.00.

From international symposium on high energy physics; Tokyo, Japan (23 Jul 1973).

A simple SU(3)-symmetric dual model for meson–baryon scattering is constructed using the crossing invariant duality solution for baryon exchange degeneracy. Predictions of the model for

forward πN scattering, for backward meson–baryon scattering, and for elastic widths of baryons are discussed. (LBS)

6252 (RL-73-103) DUAL PROPERTY OF DIFFRACTIVE RESONANCES FROM SEMILOCAL FACTORISATION. Roberts, R. G.; Roy, D. P. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

By semilocal factorization the ratio of diffractive resonance production cross sections on π and K should equal the ratio of π and K couplings to P(f) if the resonances are dual to Pomeron (normal meson) exchange. Experimental data favors the former. (auth)

6253 PHENOMENOLOGY OF SOME TWO-BODY REACTIONS AT HIGH ENERGIES. Sidhu, D. P. Stony Brook, NY; State Univ. of New York (1973). 179p. University Microfilms Order No. 73-25,770.

Thesis (Ph. D.).

High energy experimental data on some two body hadronic reactions are analyzed from a phenomenological point of view. The two body reactions considered are: πd scattering and charge exchange (Y = 0) vector meson production. Glauber theory with complications of spin and isospin is used to understand high energy πd scattering. Some realistic models of the deuteron are considered and the analysis is given in terms of best available πN amplitudes. Modifications of the simple Glauber picture are considered and the need for more experiments is emphasized. SU(3), the quark model and a Reggeized absorption model are used to discuss charge exchange vector meson production. The Regge poles used are π, ρ, B and A_2. Limitations of the available experimental data to determine the importance of A_1 exchange are considered. Particular attention is paid to the need for more experimental information to understand completely the interferences among natural and unnatural parity exchanges, to assess the importance of the A_1 exchange and to enable one to do a model independent amplitude analysis for charge exchange vector meson production. (auth) (Diss. Abstr. Int., B)

6254 TRANSFORMATION FROM CONSTITUENT TO CURRENT QUARKS IN THE SYMMETRIC QUARK MODEL. Buccella, F. (Univ., Rome); Savoy, C. A. Lett. Nuovo Cim.; 8: No. 9, 569-574(27 Oct 1973).

The axial charges for baryons in the symmetric quark model are studied. Baryons are considered in the P_z frame as symmetric states of three quarks. Meson-baryon amplitudes and resonance couplings are considered. (JFP)

6255 JOINT DESCRIPTION OF CHARGE DISTRIBUTIONS AND CORRELATIONS BETWEEN NEUTRAL AND CHARGED PARTICLES IN THE π^-p AND π^-n INTERACTIONS AT P = 40 GeV/c. Grishin, V. G.; Jancso, G.; Kuleshov, S. P.; Matveev, V. A.; Sissakian, A. N. (Joint Inst. for Nuclear Research, Moscow). Lett. Nuovo Cim.; 8: No. 9, 590-594(27 Oct 1973).

A joint quantitative description of charge distributions and correlations of neutral pions and charged tracks in π^-p and π^-n interactions at P = 40 GeV/c is presented. In this description a phenomenological model is used based on knowledge about multiparticle production at high energies which was found in studies of the coherent-state model and of the field theory models in the straight-line path approximation. (JFP)

6256 HELICITY-INDEPENDENT STRUCTURE HYPOTHESIS, PERIPHERALITY, AND πN CHARGE EXCHANGE AMPLITUDE. Inagaki, H.; Ishii, I.; Kobayashi, T.; Yamagishi, K. (Tokyo Metropolitan Univ.). Lett. Nuovo Cim.; 8: No. 9, 579-584(27 Oct 1973).

A new constraint on s-channel helicity amplitudes in the impact parameter representation called the helicity-independent structure hypothesis (HISH) is proposed. This is a less restrictive constraint on helicity amplitudes than that of the dual absorptive model in the sense that peripherality is not required explicitly in the proposed model. It is shown that the HISH plays a central role in the approach used, just as the peripherality does in the dual absorptive model, and that the peripherality of the helicity-nonflip amplitude is not the consequence of absorption effects but is due to the peripheral structure of the Regge-pole residue itself. The helicity amplitudes of $\pi^- + p \to \pi^0 + n$ interactions are successfully explained in the proposed model. (JFP)

6257 ASYMPTOTIC BEHAVIOR OF OFF-MASS-SHELL FORM FACTORS. Nakazawa, K. (Wakayama Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1755-1757(May 1973).

A simple derivation is given of the asymptotic behavior of the form factors of the nucleon is shown for $q^2 \to \infty$ with $\omega = -2qp_2/q^2$ and $p_2^2 = -W_2^2$ fixed. (JFP)

6258 NEW VALUE FOR THE SIGMA-COMMUTATOR FOR πN SCATTERING. Carter, A. A. (Queen Mary Coll., London); Bugg, D. V.; Carter, J. R. Lett. Nuovo Cim.; 8: No. 10, 639-646 (3 Nov 1973).

The sigma commutator and P- and D-wave scattering lengths are calculated for π + N interactions including for exactness the previously ignored neutron–proton mass difference. (JFP)

6259 WHAT PART OF THE REACTION $\pi P \to (n\pi)p$ IS NONDIFFRACTIVE? Moore, C. D.; Pratap, M. (State University of New York, Stony Brook, New York 11790). Phys. Rev. D 8: No. 5, 1626-1628 (1 Sept 1973).

A prescription for parametrizing πp reactions is given. As a first step towards a correct model, only pion dissociation is considered. Therefore, a reaction with an even number of pions is assumed to be totally nondiffractive, while one with an odd number of pions has, in addition, a diffractive part. Using the prescription we predict the energy dependence of various exclusive reactions. The agreement with data is found to be fairly good. The nondiffractive component dominates the inelastic reactions at intermediate energies. (auth)

6260 DIPOLE COUPLING MODEL OF REGGEON EXCHANGE. Adrams, G.S.; Barnham, K.W.J.; Bisognano, J.J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 8: No. 5, 1435-1440 (1 Sept 1973).

A complete model for the production mechanism of the double-resonance reaction $\pi N \to V\Delta$, where V is a $J^P = 1^-$ vector meson and Δ is a $J^P = 3/2^+$ isobar, is presented. The model uses dipole (J = 1) coupling at the N-Regge-Δ vertex to predict the quark-model results of classes (a) and (b). The remaining class (c) relations are not implied by this model. Only four independent helicity amplitudes are nonvanishing in the dipole model, so that quantitative fits of data will be highly overconstrained. (auth)

6261 PROPERTIES OF A SINGLE-PERIPHERAL MODEL OF THE DECK EFFECT. Yam, Y. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. D 8: No. 5, 1572-1586 (1 Sept 1973).

The properties of a single-peripheral model of the Deck effect are presented as a prototype diffraction-dissociation process, using $\pi N \to \pi pN$ as an example. The π–p mass spectrum, angular distributions, and the N–N momentum-transfer distribution are investigated. We evaluate the effects on these distributions due to three major components of the model, namely, the dissociation vertex, the propagation, and the diffraction scattering of the virtual particle. It is found that many "expected" properties (usually derived for asymptotic energies) of the diffraction-dissociation process do not obtain at finite energies. In particular, there is considerably more structure in the momentum-transfer and angular distributions. The mass dependence in the momentum-transfer slope found by others is reproduced in this model. Structure in the angular distributions is seen to imply some uncertainty over tests of helicity conservation for A_1 production. The peak in the mass spectrum (the Deck effect) is found to have an undesirable dependence on incident momentum. This difficulty is traced to the presence of spin in the model. Explicit numerical calculations and qualitative considerations lead us to believe that many Reggeized calculations of the Deck effect share the same diffculty. Their prediction a of sharp and s-independent peak is unjustified due to neglect of external spin. (auth)

6262 COMMENT ON THE πN σ TERM. Liu, Y.; Vermaseren, J.A.M. (Institute for Theoretical Physics, University Nijmegen, Nijmegen, The Netherlands). Phys. Rev. D 8: No. 5, 1602-1604 (1 Sept 1973).

The sum rule for the on-shell pion–nucleon scattering amplitude at the Cheng–Dashen (CD) point $\nu = \nu_B = 0$ has been recalculated. Instead of the value 1.7 μ^{-1} as obtained by CD, we find $T(0,0) \simeq 1.1$ μ^{-1} and 1.3 μ^{-1}, when the new and old Lovelace phase shifts are used, respectively. (auth)

6263 NEW SCHEME OF DUAL MODELS AND EXOTIC PEAKS. Eguchi, T. (Department of Physics, University of Tokyo, Tokyo, Japan); Igi, K. Phys. Rev. D 8: No. 5, 1537-1545 (1 Sept 1973).

A simple s-channel resonance model based on a new scheme of duality is proposed and is shown to explain successfully (i) the appearance of distinct exotic peaks with slopes and relative heights similar to those of the ordinary Regge exchanges, and (ii) the rapid falloff of exotic cross sections vs energy, which have been recently observed in K^-p and $\bar{p}p$ backward scattering. We also discuss the predictions of the model for the spherical-harmonic moments and the dip systematics of two-body hadronic amplitudes. In particular, the model predicts the persistence of the Odorico dips as well as the usual wrong-signature-nonsense-zero dips up to high energies if the increase of $\mathrm{Im}\alpha_s$ is not faster than linear in s. Experimental data now available support our approach. (auth)

6264 POLARIZATION EFFECTS AND ANALYSIS IN MESON + NUCLEON → MESON + MESON + NUCLEON. Kimmel, J.D.; Reya, E. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. D 8: No. 5, 1519-1533 (1 Sept 1973).

A general framework is developed for the description of nucleon polarization effects in reactions of the kind meson(0^-) + nucleon($1/2^+$) → meson(0^-) + meson(0^-) + nucleon($1/2^+$). The new information which can be obtained from target- (or recoil-) nucleon polarization measurements is delineated and high-energy predictions are given based on pion dominance of the possible unnatural-parity exchange poles. Minimum measurements required for a unique amplitude analysis are determined from a graphical technique, and specific high-energy predictions of a $\pi + A_2$ model are given for the target polarization left-right asymmetry in $\pi p \to \pi\pi^+ n$. Finally, we also discuss the simplifications that occur for general amplitude analyses if transversity amplitudes are used. (auth)

6265 ENERGY DEPENDENCE OF RESONANCE WIDTHS. Coulter, P.W.; Harms, B.C.; Jones, S.T. (Department of Physics, University of Alabama, Alabama 35486). Phys. Rev. D 8: No. 5, 1383-1387 (1 Sept 1973).

The low-energy behavior of resonance widths can be explained by centrifugal-barrier effects, but this parametrization fails above the resonant energy. A recently proposed model for an inelastic resonance shows that resonance parameters are strongly influenced by an energy-dependent background amplitude. We present calculations for the P_{33} partial wave in πN scattering which show that the width of the Δ (1236) flattens out above 1450 MeV due to these background effects. We obtain a fit to the background amplitude up to 1800 MeV and find no evidence for a resonance at 1690 MeV. (auth)

6266 COMPARISON OF THE QUARK MODEL WITH SU_3 INELASTIC AMPLITUDES. Moorhouse, R. G.; Parsons, N. (Univ. of Glasgow). Phys. Lett., 47B: No. 1, 24-28(15 Oct 1973).

A complete disagreement is found between the signs of resonance formation amplitudes for $\pi + N \to \rho + N$ and $\pi + N \to \pi + \Delta$ as predicted by the quark model and as given by the recent isobar partial wave analysis. This disagreement is in strong contrast to the corresponding agreement for resonant formation amplitudes in $\gamma + N \to \pi + N$. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 6299.

6267 (IPNO-73-15) PION-EXCHANGE AND MISSING-MASS SPECTRA NEAR THE PHASE-SPACE BOUNDARY. Pham Xuan Yem. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). May 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Pion exchange in $p + p \to p +$ other particles is shown to be kinematically enhanced at the phase-space boundary (small t large M^2s/M^2). Its contribution is significant and should be considered together with the usual terms PPP, PPf, fPP and fff of the triple-Regge formula. Some experimental implications of pion-exchange (the dip and the rising shape of the missing-mass spectrum at very small t) are discussed. (FR)

6268 (LBL-2174) WEAKLY RECURRENT POMERONS. Chew, G. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 22p. (CONF-730841-1). Dep. NTIS $3.25.

From fifth international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973).

After reviewing the evidence for weak simultaneous occurrence of one exclusive and one inclusive pomeron, experiments are described that seek two exclusive pomerons, as well as two exclusive and one inclusive. The theoretical basis for expecting weak but indefinite pomeron recurrence as the energy increases is discussed and a systematic rapidly-converging fireball expansion that brings order to a confusing picture is outlined. The widely-employed two-component model of particle production corresponds to the two leading terms. An experimentally meaningful concept of "bare" pomeron emerges naturally from the fireball expansion, as does the notion of pomeron renormalization and splitting (the schizophrenic pomeron). (auth)

6269 HELICITY STRUCTURE OF DIFFRACTION DISSOCIATION AND THE ROLE OF ABSORPTION. Sakai, N.; White, J. N. J. (Max Planck Inst. for Physics, Munich). Lett. Nuovo Cim.; 8: No. 10, 618-622(3 Nov 1973).

It is suggested that the diffraction dissociation of a definite resonant state might proceed via the absorption of a basic Born amplitude which conserves t-channel helicity. The absorption gives a dip in $d\sigma/dt$ and breaks TCHC for small j, but both these effects dissappear quickly as j increases. The scaling dipole form factor amplitude appears to be a useful approximation to the Born term in pp processes, giving reasonable results for the diffractive dissociation of the four resonances. (JFP)

6270 EFFECTS OF ISOSPIN IN THE MULTIPLE PRODUCTION OF PIONS. Calucci, G. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 8: No. 10, 601-604(3 Nov 1973).

A description is given of the multiple production of pions in the collision of two fast nucleons, where the isospin conservation is taken into account, and a comparison with an analogous treatment where the isospin variables are not considered is done. The general frame is that of the eikonal treatment of the production processes. (JFP)

6271 ANGULAR DISTRIBUTION OF p-p SCATTERING AT HIGH ENERGIES AND RADIUS OF THE HARD CORE. Nagasaki, M.; Taketani, M. (Rikkyo Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1768-1770(May 1973).

It is shown that the minimum or break at $t = 1.3$ $(GeV/c)^2$ in the experimental angular distributions for p + p interactions at high energies can be explained by a rather simple distribution of the absorption surrounding a hard core. The Klein-Gordon equation is used. (JFP)

6272 APPLICATION OF THE TRUNCATED GAUSSIAN TO THE INELASTIC PP CHARGED MULTIPLICITY DISTRIBUTION. Parry, G. M.; Rotelli, P. (International Centre for Theoretical Physics, Trieste, Italy). J. Phys., A (London); 6: No. 10, 1565-1570(Oct 1973).

It is shown that inelastic pp charged particle multiplicity distributions from 13 to 300 GeV/c can be successfully described by means of a truncated gaussian. An interpretation of this phenomenology is made through a parton-like model. Extrapolation of this fit to higher energies implies that no double-bump structure will occur, contrary to the currently fashionable two-component picture of particle production. The extension to other processes is briefly discussed. (auth)

6273 LOCAL $^1S_0$ PROTON-PROTON POTENTIAL. Kermode, M. W. (Univ. of Liverpool). J. Phys., A (London); 6: No. 11, L154-L155(Nov 1973).

A local $^1S_0$ p-p potential is introduced. This potential has an interesting shape and gives phase shifts for p-p scattering which are in very good agreement with the experimental phase shifts. (auth)

6274 CALCULATION OF THE RELATIVISTIC DEUTERON WAVE FUNCTIONS (USING SEPARABLE APPROXIMATION). Bewtra, N. K. Ithaca, NY; Cornell Univ. (1973). 99p. University Microfilms Order No. 73-28,266.

Thesis (Ph. D.).

A simple, covariant model of the deuteron was constructed. The integral equation for the DNN vertex (with one nucleon off the mass shell) with a kernel corresponding to the exchange of a pion and a scalar meson is solved exactly for a separable approximation to the kernel. The two parameters are the mass and nucleon coupling constant of the scalar meson. Using the binding energy and the quadrupole moment to fix these two parameters, reasonable values are obtained for the mass and coupling constant of the scalar and good values are obtained for the dipole magnetic moment of the deuteron and the percentage of the D-state. Indeed, it is found very easy to fit binding energy and the quadrupole moment of the deuteron with reasonable values of the mass and the coupling constant of the scalar, as long as the pion nucleon coupling constant is not too far from its customary value. Values were obtained for all of the four invariants in the d-np vertex. Thus, a covariant expression is obtained for the deuteron's structure, without the usual ambiguities from hereto unknown negative energy contributions. In particular, values are presented for the small components of the deuteron wave function. The percentage of P state is 0.95, corresponding to a P-state amplitude which is typically about 10% of the S-state. In momentum space, the negative energy components start becoming comparable to the positive energy components as the momentum increases, so their contribution to some processes may be enhanced over the contribution expected for most processes. Since pions couple strongly to the negative energy component of the nucleon many such processes will be particularly sensitive to the negative energy components of the deuteron wave function. (auth) (Diss. Abstr. Int., B)

6275 THEORETICAL ANALYSIS OF REPULSIVE CORES AND SUPPRESSION EFFECTS IN THE S-WAVE ΛN AND ΛΛ POTENTIALS AT LOW ENERGIES. Agrawal, B. B. Laramie, WY; Univ. of Wyoming (1973). 147p. University Microfilms Order No. 73-25,538.

Thesis (Ph. D.).

A two channel one boson exchange potential (OBEP) model is constructed for the $^1s_0$ ΛN, $(^3s_1 - ^3D_1)$ ΛN, and $^1s_0$ ΛΛ interactions. For the $^1s_0$ ΛΛ interaction a two channel OBEP plus two pion exchange potential (TPEP) is also constructed. In the former the ΛN scattering length and effective range are calculated as functions

of the amount of suppression of the closed ΣN channel, and in the latter the ΛΛ scattering length and effective range are calculated as functions of the amount of suppression of the closed ΞN channel. The calculations are carried out with hard core, soft core and zero core short range repulsions. When σ-meson exchange is included, a total insensitivity to the core shape results for both $^1S_0$ interactions and the effect of ΛΛ ⇌ ΞN coupling is negligibly small. Without σ-meson exchange the ΛΛ scattering length and effective range become very dependent on the amount of ΞN channel suppression and to the type of core used. In the triplet ($^3S_1 - ^3D_1$) interaction, the ΛN scattering length and effective range become dependent on the amount of ΣN channel suppression and to the type of core used each varying between 10% – 25% for the cases considered. With an OBEP plus TPEP the ΛΛ scattering and effective range become dependent on the amount of ΞN channel and to the type of core used each varying by up to 10% – 15% for the cases considered. (auth) (Diss. Abstr. Int., B)

6276 LOW ENERGY Σ⁻d SCATTERING. Damle, P. S. Laramie, WY; Univ. of Wyoming (1973). 121p. University Microfilms Order No. 73-25,543.

Thesis (Ph. D.).

Σ⁻d scattering below the threshold for deuteron break-up was studied using a Faddeev formalism. Σ⁻d elastic reaction and total cross section were calculated for quartet and doublet spin states at a Σ⁻ lab momentum of 30 Mev/c and 90 Mev/c. With the addition of results obtained from the literature for quartet Σ⁻d scattering, the spin-averaged cross sections were also calculated. In all calculations only twobody S-wave interactions were used, each of these being represented by a non-local-separable central potential. Coulomb forces were neglected and it was assumed that the hyperon-nucleon interaction did not flip the nucleon spin. Calculations were carried out for both an attractive and a repulsive Σ⁻n spin triplet interaction. Cross sections were calculated in which the Λnn channel was treated explicitly and also using an implicit lambda channel approximation (ILCA). The quartet results indicate that measurement of low-energy Σ⁻d cross sections may help in determining the Σ⁻p scattering length, but not in determining the position and width of a Λn resonance that lies 3 to 6 Mev below the Σ⁰n threshold. The other results showed that the doublet reaction cross sections as well as spin-averaged reaction cross sections varied by a factor of 1.6, when the triplet Σ⁻n interaction changes from a repulsive to an attractive interaction. It is possible, therefore, that measurement of the spin-averaged Σ⁻d reaction cross section could solve the ambiguity of the sign of the Σ⁻n interaction. It was also found that in case of a repulsive Σ⁻n interaction, the ILCA is a very good approximation. This approximation reduces the number of coupled one dimensional integral equations that need to be solved, making it easier to include nucleon spin flip, the Coulomb interaction, and other effects in the calculation. (auth) (Diss. Abstr. Int., B)

6277 DIFFRACTIVE EXCITATION MODEL FOR MULTIPARTICLE PRODUCTION IN PROTON–PROTON COLLISIONS. Kasman, R. J. Stony Brook, NY; State Univ. of New York (1973). 300p. University Microfilms Order No. 73-27,079.

Thesis (Ph. D.).

The diffractive excitation model is employed as a phenomenological framework for the study of particle production in pp collisions. The diffractive production of massive nucleons is parametrized from experimental data on pp → pp and pp → pX; several semi-statistical models for the cluster decay into pions and a nucleon are examined. From the detailed DEM kinematics essential features are extracted; the shape and energy dependence of inclusive spectra pp → pX, pp → πX, and pp → ππX is discussed. A relation between the triple-Regge couplings Pomeron-Pomeron-Reggeon and Reggeon-Reggeon-Pomeron is obtained. Employing realistic experimental parameters, a Monte Carlo computer simulation is used to generate events according to the DEM. Results for inclusive distributions pp → pX and pp → πX are in good agreement with experimental data. The energy dependence of these distributions in the variables p_{11}, x and y illustrates the approach to scaling at high energy; since the fragments of the beam and target may be viewed separately, the hypothesis of limiting fragmentation can be studied. The DEM multiplicity distribution disagrees with experiment, yielding overly large Mueller correlation parameters f_2 and f_3. This version of the DEM is compared with other work. Finally, several unsettled questions about the model are posed. (auth) (Diss. Abstr. Int., B)

6278 RELATIVISTIC EFFECTS IN LOW ENERGY NUCLEON–NUCLEON SCATTERING. Fortes, M. B. Stony Brook, NY; State Univ. of New York (1973). 110p. University Microfilms Order No. 73-25,766.

Thesis (Ph. D.).

This thesis is concerned with the relativistic aspects of the nucleon–nucleon interaction at low energies. Superpositions of one-boson-exchange amplitudes are employed to describe the interaction with the same parameters as used in semiphenomenological fits to scattering data. The relativistic corrections to these models are estimated by solving the Bethe-Salpeter equation in the ladder approximation for singlet S-waves in the elastic scattering region. Arguments are given suggesting that the effects of spin, the existence of solutions in the ladder approximation and the effects of higher-order irreducible diagrams, are adequately treated in our choice of the interaction. The results include the effects of retardation in addition to the relativistic kinematic factors. An approximation scheme is used in order to obtain relativistic three-dimensional equations that reproduce accurately the results obtained with the Bethe-Salpeter equation in the ladder approximation. These equations are closely connected with recent calculations of the two-pion-exchange contribution to the nucleon–nucleon interaction. (auth) (Diss. Abstr. Int., B)

6279 TWO APPLICATIONS OF NUCLEON MODELS. Jensen, D. W. Baltimore; Johns Hopkins Univ. (1973). 205p. University Microfilms Order No. 73-16,648.

Thesis (Ph. D.).

In the first section an extension of the parton model to high transverse momentum processes is modified to predict the inclusive two-photon correlation in pN → γγ + anything, and the connection is established between significant characteristics of the final results and the ideas underlying the concept of partons. This calculation was stimulated by an experiment at NAL, planned by the Johns Hopkins high energy physics group to measure this correlation. Based on recent evidence for high transverse momentum background pions, it is concluded that the measurement will be extremely difficult. In the second section, structure functions from a specific resonance model of inelastic e-p scattering are used to evaluate the polarizability correction to ground state hyperfine splitting in hydrogen. By requiring that the spin-flip amplitude for real Compton scattering satisfy the Drell-Hearn sum rule, the only significant free parameter in the model is fixed. A correction of ~1 ppM is calculated in agreement with existing model-independent bounds on this number. (auth)

6280 PION AND PROTON INCLUSIVE DISTRIBUTIONS IN THE DIFFRACTIVE-EXCITATION MODEL. Holden, J.P.; Robertson, D.C. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 8: No. 5, 1423-1430 (1 Sept 1973).

The leading one-particle distributions for the inclusive reaction pp → cX (c = p,π⁺) calculated in the diffractive-excitation model (DEM) are compared with the new CERN Intersecting Storage Rings data. For the pion distribution we show that a single Gaussian decay distribution, exp (– λk²), even with the added assumptions of momentum conservation and off-axis scattering of the clusters, is unable to fit the data. We then show that a pion decay distribution given by a sum of two Gaussians does fit both the fixed-x and fixed-$P_\perp^2$ distributions. The proton distributions are well fitted by a single Gaussian decay distribution. The proton spectrum exhibits a broad dip at x ≈ 0.85 which is naturally explained in the DEM as protons emanating from a cluster ($x \lesssim 0.8$) and unexcited protons recoiling against a massive cluster ($x \gtrsim 0.9$). (auth)

6281 ASYMPTOTIC EXPANSIONS OF MULTIPLICITY DISTRIBUTIONS IN HIGH-ENERGY HADRON COLLISIONS. Weisberger, W.I. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 8: No. 5, 1387-1396 (1 Sept 1973).

Steepest-descent methods are used to derive asymptotic prong distributions from the assumed limiting behavior of the multiplicity moments. A short-range and a long-range correlation model are shown to be each in agreement with proton–proton data from P_{lab} = 50 to 305 GeV/c, and to be well approximated by their asymptotic forms at the highest energy. Quantitative predictions are given which may distinguish between them in experiments at the CERN Intersecting Storage Rings. (auth)

6282 MULTIPERIPHERAL THEORY OF MASSIVE-MUON PAIR PRODUCTION IN HADRON COLLISIONS. Subbarao, K. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 5, 1498-1503 (1 Sept 1973).

Massive-lepton pair production in high-energy hadron collisions is studied in the ABFST(Amati–Bertocchi–Fubini–Stanghellini–Tonin) multiperpheral model. The cross section for point electromagnetic couplings is given by $d\sigma/dQ^2 = Q^{-4} f(s/Q^2)$ when $Q^2 \gg M^2$, where $\sqrt{s}$ is the center-of-mass energy of the colliding protons, Q the mass of the lepton pair, and M the nucleon mass. The scaling function f is expressed in terms of πN and NN off-shell forward absorptive amplitudes. When $s \gg Q^2$, the function f behaves like a $\ln(s/Q^2) + b$, Pomeron dominance being assumed. Gauge invariance of the model is discussed. (auth)

6283 MATRIX PADÉ APPROXIMANTS FOR THE $^1S_0$ AND $^3P_0$ PARTIAL WAVES IN NUCLEON-NUCLEON SCATTERING. Fleischer, J.; Gammel, J.L.; Menzel, M.T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 8: No. 5, 1545-1552 (1 Sept 1973).

In order to correct the threshold behavior of scalar Padé approximants in NN scattering, "matrix Padé approximants," which take into account the various and positive- and negative-energy states, have been considered by several authors. In a recent paper by Bessis, Turchetti, and Wortman, truncated matrices based on an incomplete set of basis states were used and a qualitative description of the energy dependence of the $^3P_0$ phase shift was obtained. In this work it is shown that this result is not obtained when a complete set of basis states is used. The main effect of matrix Padé approximants using a complete set of basis states is to introduce an additional attraction at higher energies. Our analysis of the fourth-order graphs is done in a way which allows the external momenta to be completely off shell so that the irreducible graphs can be used as kernels in the Bethe-Salpeter equation. This will make possible the calculation of several higher-order graphs by iterating the Bethe-Salpeter equation. (auth)

6284 INTERSECTING-STORAGE-RINGS INCLUSIVE DATA AND THE CHARGE RATIO OF COSMIC-RAY MUONS. Yen, E. (Department of Physics, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. D 8: No. 5, 1618-1619 (1 Sept 1973).

The (μ^+/μ^-) ratio at sea level has been calculated by Frazer et al., using the hypothesis of limiting fragmentation together with the inclusive data below 30 GeV/c. They obtained a value of $\mu^+/\mu^- \simeq 1.56$, to be compared with experimental value of 1.2 to 1.4. We have calculated the ratio using the recent ISR (CERN Intersecting Storage Rings) data, and obtained a value of $\mu^+/\mu^- \approx 1.40$ in good agreement with the experimental result. (auth)

6285 LIMITING FRAGMENTATION AND THE MUON CHARGE RATIO AT SEA LEVEL. Yekutieli, G., Rotter, S. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett., 47B: No. 1, 36-38 (15 Oct 1973).

Using the hypothesis of limiting fragmentation of hadronic collisions at high energies and recent ISR data on $pp \to \pi^\pm$ a practically constant ratio of $\mu^+/\mu^- = 1.25 \pm 0.03$ is obtained for $E_\mu \geq 50$ GeV. Contributions from the pionization region of the $pp \to \pi^\pm$ collisions to the μ^+/μ^- ratio are important. (auth)

6286 EFFECT OF THE s-WAVE $\pi\pi$ INTERACTION ON PERIPHERAL NUCLEON-NUCLEON SCATTERING. Verwest, B.; Riska, D. O. (State Univ. of New York, Stony Brook). Phys. Lett., 47B: No. 1, 1-4(15 Oct 1973).

The dependence of the two-pion-exchange contribution to nucleon-nucleon scattering in high partial waves on the model for the s-wave $\pi\pi \to N\bar{N}$ scattering amplitude below threshold for $N\bar{N}$ production is illustrated by comparing four models. Future improved pp scattering data should be used to reduce the uncertainty in the triplet F and singlet G phase shifts to enable discrimination between the models. (auth)

6287 CONDITIONS FOR THE EARLY ONSET OF KNO SCALING. Schlitt, D. W. (Univ., Utrecht). Phys. Lett., 47B: No. 1, 47-50(15 Oct 1973).

A precise definition of "early onset of KNO scaling" is given and the conditions for its experimental observation are examined. It is argued that the observed early onset of KNO scaling in the charged particle distribution in p-p scattering is due to a fortuitous maximum in the normalized moments $C_q^c = \langle N_c^q \rangle / \langle N_c \rangle^q$ and not due to any significant underlying physical mechanism. (auth)

Particle Invariance Principles and Symmetries

6288 FINITE DIFFERENCES, CLEBSCH-GORDAN COEFFICIENTS, AND HYPERGEOMETRIC FUNCTIONS. Karasev, V. P.; Shelepin, L. A. (Inst. of World Economics and International Relations, Moscow). Teor. Mat. Fiz.; 17: No. 1, 67-78(Oct 1973). (In Russian).

The generalization of the angular momentum theory is proposed, which uses as its generating representation the representation of finite generalized hypergeometric series by means of operators of finite differences and symbolic powers. A number of new relations is obtained, which generalize the conception of the coupling (the addition) of angular momenta; in particular, the expression of the Racah coefficient through the sum of products of the two Clebsch-Gordan coefficients is found. The effectivity of the finite difference method is demonstrated and the finite-difference differentiation and integration of the Clebsch-Gordan coefficients and j-symbols over angular momenta and their projections is considered. The formulas obtained by the method presented directly give the numerical values for the j-symbols and other quantities of the angular momentum theory. (auth)

General

Refer also to abstract 6799.

6289 (JINR-E2-7321) HARMONIC ANALYSIS ON THE LORENTZ GROUP AND FREE HAMILTONIAN FOR PARTICLES OF ANY SPIN. Mavrodiev, S. Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U.S. Sales Only) $3.00.

In terms of the unitary Poincare group representations and harmonic analysis on the Lorentz group basing on the quasi-potential approach the free Hamiltonian was constructed for particles of arbitrary spin. (auth)

6290 KVANTOVYE POLYA I TEORIYA GRUPP. Kurs Lektsii. (Quantum Fields and Group Theory. Course of Lectures). Rumer, Yu. B. (ed.). Novosibirsk, USSR; Novosibirskii Gosudarstvennyi Universitet (1973). 87p. (In Russian).

The purpose of these lectures is to apply group theory to the kinematics of quantum fields and to elementary particle theory by the use of Poincare group concepts. The first section contains a detailed presentation of the Poincare group and spinor algebra. The second section deals with the kinematics of quantum fields which are considered as operator concepts of the Poincare group. The laws of transformation by the Poincare group naturally lead to the Wigner unitary concepts in the space of particle states. Without involved mathematics a presentation is made of the Pauli theorem on the connection between spin and statistics, and of the Weinberg theorem on the connection between particles and fields. (auth)

6291 SUFFICIENT CONDITIONS FOR COVARIANCE OF REPRESENTATIONS OF C*-ALGEBRAS. I. Bulinskii, A. V. (Moscow Physical-Technical Inst.). Teor. Mat. Fiz.; 17: No. 1, 19-23(Oct 1973). (In Russian).

For a compact group G of automorphisms some conditions are considered, which imply the unitary equivalence of a representation π of C*-algebra A to the G-covariant representation ρ of A. (auth)

6292 CONFERENCE ON GROUP THEORY. Proceedings of a Conference Held in Racine, Wisconsin, June 28-30, 1972. Gatterdam, R. W.; Weston, K. W. (ed.). Lecture Notes in Mathematics, Vol. 319. Berlin; Springer Verlag (1973). 109p. (CONF-720695-). $6.70.

From conference on group theory; Racine, Wisconsin, USA (28 Jun 1972).

The topics discussed are the structure of Hecke algebras, locally extended residually finite groups, the conjugacy problem for Knot groups, exceptional primes in varieties, group with free subgroups of finite index, free subgroups of linear groups, groups of exponent four IV, the Higman theorem for $E^n(A)$, computable groups, ring theoretic methods and finiteness conditions in infinite soluble group theory, the index of an algebra automorphism group, and groups of exponent four. Also covered are primary abelian groups and normal structure of their automorphism groups, countable type local theorems in algebra, on powers, conjugacy classes and small cancellation groups, the orders of generation of SL(2,R), centrally separated elements in groups, the restricted Burnside problem for groups of exponent 8 on 2 generators, groups whose images have a transitive normality relation, polycyclic group rings and the nullstellensatz, SQ-universal 1-relator groups, the cohomology of pregroups, and a survey of SQ-universality. (JFP)

Applications (Electromagnetic and Weak)

Refer also to abstracts 6193, 6214, and 6244.

6293 (EFI-TF-1(71)) REMARKS ON C-INVARIANCE TESTS IN EXPERIMENTS ON COLLIDING e^+e^- BEAMS. Khoze, V. A. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 8p. (In Russian). INIS.

Questions were considered on the effect of the polarization of the original particles on the C-invariance tests in the production of hadrons during e^+e^- collisions. It was shown that the production of resonances with CR = −1 in experiments on colliding e^+e^- beams was forbidden with a precision up to the term $\sim(M_e/M)^2$, where M is the resonance mass. (tr-auth)

6294 HIDDEN SYMMETRIES AND K_{l3} FORM FACTORS. Rest, J. (Argonne National Lab., IL). Lett. Nuovo Cim.; 8: No. 11, 697-702(10 Nov 1973).

A model consisting of eight physical pseudoscalar fields and characterized by a hidden SU(3) symmetry is presented. The model is applied to K_{l3} decay and relations among the K_{l3} form factors are obtained. (LBS)

6295 NON-HERMITIAN INTERACTIONS AND THE EVIDENCE FOR VIOLATION OF T INVARIANCE. Kenny, B.G.; Sachs, R.G. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 8: No. 5, 1605-1607 (1 Sept 1973).

It is shown that the usual argument based on the Bell-Steinberger sum rule to the effect that the data on neutral-K-meson decay provide evidence that T invariance must be violated contains a logical weakness because T-invariant, CPT-violating interactions that are non-Hermitian would abrogate the sum rule, which is a unitarity condition. The required modification of the sum rule for such an interaction is given explicitly but it introduces several quantities that cannot be measured directly; therefore the modified sum rule does not provide useful general information concerning the validity of T invariance. (auth)

Applications (Strong)

Refer also to abstract 6191.

6296 QUARKS: CURRENTS AND CONSTITUENTS. Melosh, H. J. IV. Pasadena, CA; California Inst. of Tech. (1973). 74p. University Microfilms Order No. 73-26,472.

Thesis (Ph. D.).

In this thesis an attempt is made to clarify the connection between two physically different $SU(6)_W$ algebras. The one $SU(6)_W$ is an approximate symmetry group, and leads to the idea that hadrons are composed of just a few "constituent" quarks. The other $SU(6)_W$ is an algebra of physically observable operators, integrals over various components of vector, axial, and tensor currents. These currents behave, algebraically, as if they were simple bilinear combinations of "current" quark fields. It is proposed that these two physically different algebras are related by a unitary transformation. This transformation is necessarily very different from the identity. Several properties of this transformation are identified, and the transformation is then constructed explicitly in the free quark model, where it yields an exactly conserved $SU(6)_W$ symmetry of constituent quarks. It is then shown how this transformation may be constructed in models with interacting quarks. In general, the algebraic structure of the transformation depends upon the dynamical details of the interaction. The effect of interactions is discussed in more detail, distinguishing two cases. In one case the structure of the transformation in the interacting model need not have any relation to that of the free quark model. In the other case, the algebraic structure of the two transformations is the same. The algebraic structure of of the transformed currents in nature seems to be roughly that given by the free quark model transformation. The mechanism by which this occurs is obscure at present, and no clearcut distinction can be made between the two cases. As we have indicated, the last section is devoted to the application of the algebraic structure of the free quark model transformation to the matrix elements of physical currents. Many successful approximate relations among matrix elements are obtained, not the least of which is the recovery of the famous ratio $\mu_T(\text{proton})/\mu_T(\text{neutron}) = -3/2$. (auth) (Diss. Abstr. Int., B)

6297 REDUCTION OF SU(n) WITH RESPECT TO SO(n) AND THE 56, $L = 2^+$, LEVEL OF THE SYMMETRIC QUARK MODEL. Brunet, M. L. Buffalo; State Univ. of New York (1973). 118p. University Microfilms Order No. 73-19,179.

Thesis (Ph. D.).

The present work is divided into two more or less distinct parts. Part I deals with a mathematical problem, the reduction of SU(n) with respect to its subgroup SO(n). This is a problem in mathematical physics, i.e., a mathematical problem which has more or less immediate applications in physics. The immediate aim of the solution of this problem is to construct a closed form expansion of the highest weight boson creation operator states for SU(n) reduced with respect to SO(n). This expansion is carried out by introducing the idea of a semigroup expansion for the highest weight states of the reduction problem. We derive the branching rule for this reduction problem for irreducible representations of SU(n) characterized by Young diagrams having at most three non-zero row lengths and show that this branching rule has the structure of a commutative semigroup. It is then shown that the branching rule without multiplicity for the reduction problem possesses the structure of a commutative semigroup and that the morphism of the latter semigroup with the former is the decisive factor in obtaining the expansion. We deal with the special cases SU(k) reduced with respect to SO(k), k = 3,4,5,6, by limiting the general expansion to these special cases. The generalization of the semigroup expansion for the highest weight states to the more general case SU(n) reduced to an arbitrary compact Lie subgroup is discussed. In Part II the mass spectrum for the positive parity baryons assigned to the 56, $L = 2^+$ level of the symmetric quark model is treated. (auth)

6298 (8,8)-SYMMETRY BREAKING AND THE DECAY RATE $\eta' \to \eta\pi\pi$. Ali, A. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 8: No. 5, 1441-1445 (1 Sept 1973).

The decay $\eta' \to \eta\pi\pi$ is studied, in the framework of the soft-meson current-algebra technique, by assuming that the symmetry-breaking part of the strong-interaction Hamiltonian transforms as the (8, 8) representation of SU(3) ⊗ SU(3). It is found that $\Gamma(\eta'\to\eta\pi\pi)$ varies from 1.2 MeV to 5.9 MeV depending upon the value of the Dalitz-slope parameter α. (auth)

6299 KOBA-NIELSEN-OLESEN SCALING AT FINITE ENERGIES. Chodos, A.; Rubin, M.H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104); Sugar, R.L. Phys. Rev. D 8: No. 5, 1620-1623 (1 Sept 1973).

Since Slattery's analysis of the Serpukhov and National Accelerator Laboratory (NAL) multiplicity data shows Koba-Nielsen-Olesen (KNO) scaling behavior to remarkable accuracy, it is of interest to examine KNO scaling at finite energies. We discuss the fact that KNO's argument in favor of asymptotic scaling fails at any finite energy, and the corrections exceed the experimental limits at NAL energies. We show that energy conservation forbids exact moment scaling in any finite energy range, and we establish a sufficient condition for a distribution to obey scaling within the observed accuracy. We further point out the first two moments calculated by Slattery are independent. Finally, we produce a simple model showing how unitarity can generate the long-range correlations in the rapidity variable that KNO scaling implies. (auth)

6300 CURVED INTERNAL SPACE AND BARYON MASS FORMULA. Araki, S. (Rakuno-Gakuen Univ., Ebetsu, Japan). Lett. Nuovo Cim.; 8: No. 10, 647-650(3 Nov 1973).

The single-valued representation of SO(4,1) de Sitter group related to the hadron structure in a similar manner to a previous work is investigated. (JFP)

Scattering Theory

Refer also to abstracts 6087, 6621, and 6814.

6301 SCATTERING PROBLEM IN THE THEORY OF STRONG COUPLING. Arkhipov, A. A.; Tyurin, N. E. (Inst of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 17: No. 1, 57-66 (Oct 1973). (In Russian).

In the strong coupling theory the interaction potential is obtained in the nonrelativistic approximation. (auth)

6302 SEMICLASSICAL APPROXIMATION OF THE RADIAL EQUATION WITH TWO-DIMENSIONAL POTENTIALS. Berry, M. V.; De Almeida, A. M. O. (Univ. of Bristol, Eng.). J. Phys., A (London); 6: No. 10, 1451-1460(Oct 1973).

The radial equation for scattering from a cylindrically symmetrical potential is examined, because two-dimensional scattering arises in high energy electron diffraction from crystals. Particular attention is paid to the case of s waves, where there is a centripetal attractive potential for free particles. After showing that the Langer transformation, which leads to correct semiclassical wave functions for all other cases in two and three dimensions, fails for s waves, the method of comparison equations is applied, which enables one to express the phase shifts and bound state conditions in a simple form valid for all angular momenta. The theory is tested for s waves by comparison with exactly-calculated energy levels. (auth)

6303 REPRESENTATIONS OF CANONICAL COMMUTATION RELATIONS IN THE LIMIT OF INFINITE VOLUME. Aref'eva, I. Ya.; Kulish, P. P. (Leningrad Mathematical Inst.). Teor. Mat. Fiz.; 17: No. 1, 3-18(Oct 1973). (In Russian).

The representation of the Weyl group in the renormalized space for the Yukawa model without cut-off is obtained. It is shown that this representation is globally disjoint from the Fock representation, but is locally Fock. (auth)

6304 GROUP VELOCITY AND THE MACROCAUSALITY CONDITIONS FOR THE FORWARD SCATTERING AMPLITUDE. Lyuboshits, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1316-1326(Oct 1973). (In Russian).

Macrocausality conditions for the "forward" scattering amplitude are formulated on basis of an analysis of the propagation of a wave packet in a macroscopic medium. It is shown, in particular, that for particles with a zero rest mass the real part

of the scattering amplitude at zero energy cannot be positive if the ratio Im $a(\kappa)$/Re $a(\kappa)$ tends to zero as $\kappa \to 0$. (auth)

6305 PHYSICAL INTERPRETATION OF THE MULTIPARTICLE GENERATING FUNCTIONAL AND PARTITION FUNCTION. Blankenbecler, R. (Department of Physics, Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8; No. 5, 1611-1615 (1 Sept 1973). Phys. Rev. D 8: No. 5, 1611-1615 (1 Sept 1973).

It is shown that the multiparticle generating functional and the multiplicity generating function (or partition function) are experimental observables and can be measured directly for finite ranges of their parameters. Their derivatives can also be measured directly. Since these functions are observables, they are subject to statistical fluctuations due to the necessarily finite number of measurable events used in their evaluation. The expected rms fluctuations of the partition function are shown to be simply expressed in terms of the total number of events and the partition function itself. Examples are given to clarify these results and their physical interpretation. (auth)

6306 ON THE UTILITY OF SEPARABLE EXPANSIONS FOR THE t MATRIX. Levinger, J.S. (Institut de Physique Nucléaire, Division de Physique Théorique, 91406, Orsay, France). J. Math. Phys. (N.Y.) 14: No. 10, 1314-1315 (Oct 1973).

Osborn used the property of compactness to show that there is an infinite mean square deviation between the t matrix for a local potential and any separable t matrix of finite rank. I present an alternate proof, using only the property of square integrability. The divergence of the mean square deviation arises from very large momenta. I argue that a separable t matrix can give a good approximation to the trinucleon energy, which is insensitive to values of the t matrix at very large momenta. (auth)

6307 TRANSITION FROM TIME-DEPENDENT TO TIME-INDEPENDENT MULTICHANNEL QUANTUM SCATTERING THEORY. Chandler, C. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131); Gibson, A.G. J. Math. Phys. (N.Y.) 14: No. 10, 1328-1335 (Oct 1973).

Rigorous proofs are given of several theorems establishing the connection between time-dependent and time-independent multichannel scattering theory. The method of proof involves a two-Hilbert-space formulation of time-dependent multichannel theory and the theory of spectral integrals. In particular, the time-independent theory in the form proposed by Alt, Grassberger, and Sandhas is derived. (auth)

6308 MODIFIED LIPPMANN-SCHWINGER EQUATIONS FOR TWO-BODY SCATTERING THEORY WITH LONG-RANGE INTERACTIONS. Prugovečki, E.; Zorbas, J. (Department of Mathematics, University of Toronto, Toronto M5S 1A1, Canada). J. Math. Phys. (N.Y.) 14: No. 10, 1398-1409 (Oct 1973).

Two kinds of modified Lippmann-Schwinger equations are derived for the case of long-range potentials. The equations of the first kind are homogeneous and are a direct result of the fact that the standard Lippmann-Schwinger equations do not hold when long-range forces are present. The equations of the second kind depend on the existence of an operator Z such that $W_+ = s\text{-}\lim \exp(iHt)Z \exp(-iH_0t)$. A general recipe for constructing Z is given and its computation is carried through for the case of asymptotically Coulombic potentials. The resulting equations are used to compare the long-range theory with the theory with a space cutoff (i.e., screened potential) in the limit in which that cutoff is being removed. (auth)

6309 OPTIMIZED POLYNOMIAL APPROXIMATION TO SOLVING INTEGRAL EQUATIONS: LIPPMANN-SCHWINGER EQUATION. Chao, Y. A. (Rutherford High Energy Lab., Chilton, Eng.); Jackson, A. D. Nucl. Phys.; A215: No. 1, 157-177(1973).

The optimized polynomial approximation is applied to solving the Lippmann-Schwinger equation. Simple prescriptions for practical usage are given for the case of a general superposition of Yukawa potentials. Detailed results are presented for the Malfliet-Tjon $^3S_1$ potential as a representative demonstration of the power of the method. For comparable accuracy it is seen that the use of optimum variables reduces the dimension of the relevant matrix equations by a factor of approximately 3. (auth)

6310 (SLA-73-5946) COMMENT ON A RECENT PAPER OF ROSENBERG. Chandler, C.; Gibson, A. G. (New Mexico Univ., Albuquerque (USA)). 1973. 3p. Dep. NTIS $3.00.

A time-independent formula recently proposed by Rosenberg for the scattering operator for systems involving charged particles is shown to be erroneous. Specifically, it is shown that his scattering amplitude is zero. (auth)

PHYSICS (LOW-TEMPERATURE)

6311 (COO-1569-102) EXPERIMENTAL AND THEORETICAL STUDIES IN SOLID STATE AND LOW-TEMPERATURE PHYSICS. Annual Progress Report for 1973. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1973. Contract AT(11-1)-1569. 55p. Dep. NTIS $4.75.

Experimental and theoretical investigations have been carried out in a broad area of low temperature and solid state physics which includes superconductivity, theory of quantum crystals, magnetism in metals, and liquid helium. The pair-field susceptibility of a superconductor has been determined both above and below T_c. Anomalies in the heat capacity in the vicinity of T_c have been observed in thin superconducting films. The theory of quantum crystals has been applied to the problem of the ground state properties of nucleon matter. The results imply that most of the neutron matter in every neutron star is in the crystalline phase. Enhanced hyperfine nuclear cooling of $PrCu_6$ has been used successfully to achieve temperatures to at least 3 mK with slow warmup. Measurements on local moments in metals using nuclear orientation are being carried out at these temperatures. Preliminary results have been obtained in measurements of the differential osmotic pressure in the critical region of $^3He/^4He$ mixtures. Evidence has been found for surface film superfluidity in mixtures in regions of the phase diagram where the bulk liquid is normal. A new ac technique has been developed to study superfluid flow through fine channels in a manner analogous to the study of I–V characteristics of superconducting weak links. (auth)

Superfluidity

Refer also to abstract 6405.

6312 (COO-3161-17) ONSET OF SUPERFLUID FLOW IN THIN HELIUM FILMS. Kosterlitz, J. M. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics; Birmingham Univ. (UK). Dept. of Mathematical Physics). Oct 1973. Contract AT(11-1)-3161. 11p. Dep. NTIS $3.00.

The onset of superfluid flow in thin He II films is discussed on the basis of a recent theoretical model, and it is shown that it is in good agreement with experiment. (auth)

6313 (INP-821) HIGH-MOMENTUM EXCITATIONS IN LIQUID ^4He. Parlinski, K. (Institute of Nuclear Physics, Krakow (Poland)). Jan 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

The dynamic structure factor $S(\omega,k)$ of liquid ^4He, approximated by two δ-functions in ω, is calculated for $k > 2$ A^{-1} at 0 K on the basis of four moments. One of the δ-functions, which corresponds to the center of main distribution observed by the neutron scattering method, exhibits oscillatory deviations from the energy of free helium atoms. These oscillations have been found to be in good agreement with the experimental data of Cowley and Woods. The width of the same distribution, approximated by the Gaussian form, is also estimated and general agreement is established. (auth)

6314 (RL-73-89) HEAT TRANSFER TO LIQUID HELIUM IN PULSE-HEATED CHANNELS. Bailey, R. L. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Aug 1973. 30p. Dep. NTIS (U.S. Sales Only) $3.50.

Channel wall temperature rises were experimentally investigated in 0.8 mm × 10 mm cross section channels of lengths up to 200 mm. The stainless steel walls were tested with and without thin resin coatings and in different orientations. Tests were made on similar surfaces in open pool boiling for comparison. Pulse-heating did not produce any significant increase in temperature above continuously heated values. Orientation was a big factor in pool boiling and remained so in channels. Recommendations are made on how best to predict heat transfer in channels. (auth)

6315 RAYLEIGH DISK IN dc HELIUM II COUNTERFLOW. Lynch, R.F.; Pellam, J.R. (Physics Department, University of California, Irvine, California 92664). Phys. Rev. Lett. 31: No. 1, 17-19 (2 July 1973).

The torque on a Rayleigh disk in dc helium II counterflow produced by a heater has been measured over the range 0.969 K to T_λ. We find that the response of the disk is roughly the same for normal fluid and superfluid. A torque deficit of $\simeq$50% of that from potential-flow theory appears to be explainable in terms of turbulent, supercritical flow in the channel, rather than anomalous disk behavior. These findings are in contradiction to a number of other studies involving net mass flow relating to the "λ-point anomaly" of Pellam. (auth)

6316 HELICITY MODULUS, SUPERFLUIDITY, AND SCALING IN ISOTROPIC SYSTEMS. Fisher, M.E. (Baker Laboratory, Cornell University, Ithaca, New York 14850); Barber, M.N.; Jasnow, D. Phys. Rev. A 8: No. 2, 1111-1124 (Aug 1973).

The ordered state of a d-dimensional isotropic system with an n-vector ($n \geq 2$) order parameter is considered. By the imposition of suitable boundary conditions it is shown how to define explicitly a helicity modulus Υ (T) which measures the free-energy increment associated with "twisting" the direction of the order parameter. For a Bose system the superfluid density is seen to be $\rho_s(T) = (\eta/\hbar)^2\Upsilon(T)$. A critical exponent ν is defined by $\Upsilon(T) \sim |T-T_c|^{\nu}$ as $T \to T_c$ for an ideal Bose gas and spherical model ($n \to \infty$), $\nu = 1$ is an exact result for all $d > 2$. The difficulties of defining a correlation length in the ordered phase are discussed. A full scaling theory of the correlations avoids these problems and may be linked to a phenomenological hydrodynamic approach, to clarify and rederive Josephson's relation $v = 2\beta - \eta\nu = 2 - \alpha - 2\nu$. This reduces to $v = (d-2)\nu$ (used by some authors with $d = 3$), only if one accepts d-dependent, "hyperscaling" relations such as $d\nu = 2 - \alpha$; however, both these latter relations fail for the ideal Bose gas when $d > 4$. An alternative derivation of the formula $v = 2 - \alpha - 2\nu$ is based on the scaling theory for systems with a large but finite dimension. (auth)

6317 FLOW OF SUPERFLUID HELIUM THROUGH A BED OF LARGE ANGULAR PARTICLES. Hess, G.B. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. A 8: No. 2, 899-904 (Aug 1973).

In several different theoretical models, the critical velocity for onset of dissipation in superfluid flow through a packed bed of particles appears as a condition for escape of segments of quantized vortex line pinned between particles. This condition has essentially the form of the Feynman critical velocity based on particle diameter d; thus the predicted critical velocity is of order h/md and is independent of temperature. This is in accord with the well-known increase in critical velocity when a tube is packed with fine powder, but predicts a decrease for coarse powder. Measurements of superfluid flow through a glass tube constricted to 390-μm diam and packed with 35-μm silicon-carbide grains give a critical velocity of 1.6 cm sec^{-1}, nearly constant over the temperature range $1.35 < T < 2.13$ K. This is considerably slower than the flow observed in the empty tube (at least for $\Delta p \gtrsim 0.1$ dyne cm^{-2}). The results are not sensitive to the vortex nucleation or regeneration processes, which would distinguish between theoretical models. (auth)

6318 He-II FILM TRANSFER RATES FOR SOLID-Ar BEAKERS. Milbrodt, T.O.; Pollack, G.L. (Physics Department, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. A 8: No. 2, 930-937 (Aug 1973).

Helium-II film transfer rates have been measured for filling and for emptying beakers of solid Ar. Liquid Ar was frozen slowly in a mold which was later removed, leaving free-standing transparent solid-Ar beakers. The beakers used were of 3-mm i.d., 5-mm o.d., and 3.5 cm in height. Experiments were carried out in the temperature range 1.45-2 K. The dependence of the transfer rate σ (cm^3/s cm of circumference) on the difference between inner and outer He levels Z, height of the beaker lip above the level of the liquid source H, and temperature was studied. The transfer rates were lower than those observed with glass beakers, in agreement with theory. For beaker fillings with a level difference of 1 mm and at a temperature of 1.66 K, the measured transfer rates may be described by the relation $\sigma = 4.8\ H^{-0.21} \times 10^{-5}$ cm^2/s, where H is in cm. (auth)

6319 CRITICAL PHENOMENA IN SYSTEMS OF FINITE THICKNESS. III. SPECIFIC HEAT OF AN IDEAL BOSON FILM. Barber, M.N.; Fisher, M.E. (Baker Laboratory, Cornell University, Ithaca, New York 14850). Phys. Rev. A 8: No. 2, 1124-1135 (Aug 1973).

The specific heat at constant density of an ideal-Bose-fluid film of thickness $L = l\rho^{-1/3}$, but infinite lateral extent, is calculated analytically to order l^{-2}. Both hard-wall and periodic boundary conditions are considered. Good agreement with the numerical calculations of Goble and Trainor for the total specific heat under hard-wall conditions is obtained down to $l \simeq 10$. In the critical region, the large-l behavior accords with the scaling theory of finite-size effects. The appropriate scaling functions and the surface specific heat are explicitly calculated. (auth)

6320 DYNAMICS NEAR PHASE TRANSITIONS: LIQUID HELIUM AND ANTIFERROMAGNETS. Hohenberg, P. C. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 284-341 of Proceedings of the International School of Physics "Enrico Fermi." Course LI. Green, M. S. (ed.). New York; Academic Press, Inc. (1971).

From international school of physics, Enrico Fermi; Varenna, Italy (27 Jul 1970). See CONF-700733-.

The general features of the thermodynamics and hydrodynamics

of superfluids are discussed, and the analogy with a simple magnetic model is introduced. The phenomenological theory of critical dynamics, the so-called dynamic scaling theory, and its application to thermal phenomena in liquid helium are presented. Ultrasonic propagation in liquid helium is discussed. Since sound waves couple only weakly to the order parameter, the original dynamic scaling theory does not account for the absorption and dispersion of sound near T_λ. Isotropic and anisotropic antiferromagnets are discussed. Crucial differences are pointed out between the hydrodynamic behavior of these two systems away from the critical point. The corresponding differences in critical behavior are discussed in connection with recent neutron scattering experiments. For both isotropic and anisotropic systems, these experiments yield quantitative confirmation of the validity of dynamic scaling. (MHR)

6321 NONZERO WAVE-NUMBER EFFECTS ON SECOND SOUND IN He II. Cunsolo, S.; Jacucci, G. (Univ., Rome). pp 578-580 of Proceedings of the International School of Physics "Enrico Fermi." Course LI. Green, M. S. (ed.). New York; Academic Press, Inc. (1971).

From international school of physics, Enrico Fermi; Varenna, Italy (27 Jul 1970). See CONF-700733-.

Some measurements reported elsewhere on the second sound phase velocity at high values of the wave number close to the lambda point are discussed in connection with finite wave number effects on the properties of the critical mode and the departure from hydrodynamic behavior. (MHR)

6322 FIRST VISCOSITY O F THE BALIAN-WERTHAMER PHASE OF SUPERFLUID HELIUM-3. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 277: No. 5, 115-118 (30 Jul 1973). (In French).

Further developments are presented in calculations of the first viscosity eta of the Balian–Werthamer phase of superfluid helium. (FR)

6323 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI", VARENNA, ITALY, JULY 27 – AUGUST 8, 1970. Course LI. Critical Phenomena. Green, M. S. (ed.). New York; Academic Press, Inc. (1971). 594 p. (CONF-700733-). $32.00.

From international school of physics, Enrico Fermi; Varenna, Italy (27 Jul 1970).

Twenty lectures are presented. Separate abstracts are given for two lectures. (MHR)

For abstracts of individual lectures see: 6320 and 6321.

6324 METASTABLE STATE OF ROTATING HELIUM II WHEN ITS ROTARY SPEED IS SUDDENLY CHANGED. Nadirashvili, Z. Sh.; Tsakadze, Dzh. S. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 43-45 (20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 77-79 (20 Jul 1973).

Previous studies have shown that helium II rotating in a transcritical regime can remain in a metastable state for a long time. Unlike those where the vortices vanish or are formed in groups when the rotary speed is varied smoothly and slowly, results are reported here of experiments in which the rotary speed of the apparatus was decreased almost instantaneously. It is concluded that the decay of the vortex system when the rotation of the helium II stops differs strongly from the decay of the excess vortices following a sudden decrease of the rotary speed. (MHR)

Superconductivity

Refer also to abstracts 5518 and 5549.

6325 (COO-3153-110) MULTILAYERED THIN FILM SUPERCONDUCTORS. Report No. 2041. Rickenbach, R. C. (Cornell Univ., Ithaca, N.Y. (USA). Materials Science Center). Jun 1973. 81p. Dep. NTIS $6.25.

Thesis.

A vapor deposition system for the production of multilayered thin films has been built. The essential idea of the system is to evaporate the materials for both layer types simultaneously and to form the layered structure through the use of a rotating shutter which periodically intercepts one evaporation source and then the other. The system has been used to make Pb–Al layered films. The thicknesses of the individual layers was varied from 60 to 600 Å. Results from a preliminary study of the superconducting properties of the layered films are given. (auth)

6326 (COO-3164-5) STUDIES OF LOW TEMPERATURE PHASE TRANSFORMATION IN HIGH FIELD SUPERCONDUCTORS AND THE PHONON SPECTRUM AND MECHANICAL PROPERTIES OF VANADIUM. Final Report. Batterman, B. W. (Cornell Univ., Ithaca, N.Y. (USA). Dept. of Materials Science and Engineering). 1972. Contract AT(11-1)-3164. 6p. Dep. NTIS $3.00.

Extensive studies of the structure and phase transformations of high field superconductors of the β-tungsten type were made. A phase transformation was discovered at 43°K in Nb_3Sn and the structure of the low temperature phase was measured. The details of the transformation in terms of the formation of the low temperature tetragonal phase from the high temperature cubic phase was investigated both by x-ray observations and optical microscopy below 40°K. The complete phonon dispersion of vanadium was measured by x-ray diffuse scattering, thus complementing the neutron measurements on other body-centered cubic elements. Incidental to the work on phonons in vanadium a strong effect was discovered which was related to hydrogen precipitations in vanadium. In separate electron microscopy studies the structure of the vanadium hydride phase was determined directly and the relative positions of the hydrogen atoms were determined. In a neutron diffraction study complementing the phonon work with x-rays the existence of anharmonic vibrations in single crystals of silicon was shown directly by determining, for the first time, a nuclear forbidden reflection. This reflection is due solely to anharmonic vibration of the nucleus of the atom and it was shown that its intensity increases with increasing temperature roughly as the 4th power of temperature. (auth)

6327 EFFECT OF MAGNETIC IMPURITY IN TWO-BAND MODEL OF SUPERCONDUCTOR. Choudhury, B. J. (Baranas Hindu Univ., India). Fizika (Zagreb); 5: No. 3, 117-124(Aug 1973).

Perturbation theory is used to determine the change in transition temperature of a two-band superconductor due to the presence of magnetic impurity. Localized exchange interaction between the impurity spin and electron is considered. This interaction can lead to both inter-band and intra-band scattering. It is found that the d-band transition temperature decreases more than the s-band transition temperature due to the addition of impurity. This distinction arises because the d-band gap is larger than the s-band gap. (auth)

6328 TUNNELING BETWEEN SUPERCONDUCTORS IN THE VORTEX STATE. Band, W.T.; Donaldson, G.B. (Department of Physics, University of Lancaster, Lancaster, United Kingdom). Phys. Rev. Lett. 31: No. 1, 20-22 (2 July 1973).

Superconductor–insulator–superconductor (S–I–S) and S_1–I–S_2 tunnel junctions have been studied with the thin-film electrodes in a dilute vortex state, at temperatures such that the tunneling is predominantly due to the vortex–core excitations. We conclude that the vortex cores in the upper film lie on top of those in the lower film, but that the net tunneling transition probability between vortex–core states is very much smaller than usual tunneling probabilities. (auth)

6329 INFLUENCE OF DEFECTS ON THE INTERNAL FRICTION IN SUPERCONDUCTORS NEAR THE NORMAL–SUPERCONDUCTING TRANSITION. Postnikov, V.S.; Miloshenko, V.E.; Zolotukhin, I.V.; Shunin, G.E.; Shukhalov, E.I. (Voronezh Polytechnic Institute). Sov. Phys.–Solid State 14: No. 11, 2911-2911 (May 1973).

The influence of extended structure defects in polycrystalline and single-crystal samples of niobium on the internal friction was studied by the method of flexural vibrations of a cantilevered sample. (CES)

6330 TWO-PHOTON ABSORPTION IN SUPERCONDUCTORS. Genkin, V.M.; Genkin, G.M. (Radiophysical Scientific Research Institute, Gor'kii). Sov. Phys.–Solid State 14: No. 11, 2732-2736 (May 1973).

Two-photon absorption of electromagnetic waves in superconductors is studied. An expression is derived for the time-dependent Green's functions at finite temperatures which is accurate up to cubic terms with respect to the field. In this calculation, an allowance is made for the modification of the gap caused by an alternating electromagnetic field. It is shown that the characteristic length governing the variation of the superconductivity parameter of pure superconductors in high-frequency fields is of the order of the mean free path if the frequency of the electromagnetic field is equal to the gap. The relevant correction to the surface resistivity of the superconductor is evaluated. (auth)

6331 NONLINEAR MICROWAVE PROPERTIES OF NARROW SUPERCONDUCTING FILMS. Gubankov, V.N.; Likharev, K.K.; Pavlov, N.B. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 14: No. 11, 2721-2725 (May 1973).

The static and microwave (10 GHz) properties of long (1 cm) but narrow (8 μ) superconducting thin ($\approx$1000 Å) tantalum films were investigated. The temperature dependence of the critical current I_c was determined near T_c=2.55°K and a study was made of the influence of

temperature on the change in the microwave admittance due to the passage of a current smaller than I_c. The value of I_c was found to be considerably smaller than the depairing current and was of the same order of magnitude as the current deduced from the vortex model even at those temperatures at which the characteristic depth of penetration of a transverse magnetic field exceeded the width of the film. The change in the imaginary part of the microwave conductivity $\Delta\sigma_2$ was found to be about three times as large as that deduced on the assumption that the relaxation time τ of the order parameter of the superconducting condensate was large ($\omega\tau \gg 1$). This change was approximately equal to the value calculated on the assumption that $\omega\tau \ll 1$. The possibility of influence of simulation effects on the value of $\Delta\sigma_2$ was considered. (auth)

6332 ABSORPTION OF SURFACE ACOUSTIC WAVES IN SUPERCONDUCTORS. Sorokin, G.A. (L. D. Landau Institute of Theoretical Physics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 14: No. 11, 2683-2685 (May 1973).

The absorption of surface acoustic waves in Pippard superconductors in a magnetic field applied in the direction parallel to the surface is studied, and equations are derived for the dependence of the absorption coefficient on the frequency and the magnetic field. In fields $H > H_2 \approx H_c(\delta_L/\xi_0)^{1/3}$, the main contribution to the absorption comes from the discrete surface states, since the contribution of the continuous spectrum is exponentially small. Quantum oscillations of the absorption have an amplitude $\Gamma_0 \approx \Gamma_n(H/H_c)(\delta_L/\lambda\!\!\!^{-})$, where Γ_n is the absorption coefficient of surface acoustic waves in a normal metal; a is the interatomic distance; and $\lambda\!\!\!^{-}$ is the wavelength. The monotonic part of the absorption coefficient is of the order of $\Gamma_0 \approx \Gamma_n H/H_c(\delta_L/\lambda\!\!\!^{-})$; the relatively large value of Γ_0 is attributed to a high density of surface states. The possibility of experimental observation of such oscillations is discussed. (auth)

6333 RESISTANCE OF THIN SUPERCONDUCTING FILMS IN THE DYNAMIC MIXED STATE. Gubankov, V.N. (Institute of Radio Technology and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 14: No. 9, 2264-2266 (Mar 1973).

The effect of temperature on the viscous motion of vortices in thin superconducting tin films satisfying the "contamination limit" was studied. The temperature dependence of the viscosity η was determined by measuring the differential resistance as a function of magnetic field at various temperatures. In the range $T \approx T_c$, there was a relative increase in η (T), stronger in films with a long free path. This behavior of η agrees with the predictions of the microscopic theory and is due to the increase in the anomalous part of the relaxation losses close to T_c. The conditions for a valid comparison between theory and experiment are discussed. (auth)

6334 EFFECT OF TUNNEL EXTRACTION OF EXCITATIONS FROM A SUPERCONDUCTOR ON THE SUPERCONDUCTING PHASE TRANSITION. Aronov, A.G.; Gurevich, V.L. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 14: No. 9, 2309-2311 (Mar 1973).

A study has been made of the nonequilibrium state of a superconductor which arises from tunneling transitions. In this state there is a change (a decrease) both in the total number of superconducting excitations and in their energy distribution. This should increase T_c since the critical temperature depends on the number of excitations and their distribution. Here a double tunneling structure, composed of a film of a superconductor, both of whose surfaces are covered with dielectric layers, is treated. Two semiconductors (p and n types) are in contact with these dielectric films. During tunnel transitions holes from under the superconducting gap pass into the n–type material while quasiparticles from the region above the gap pass into the p–type material. Their escape is possible due to creation of excitation–hole pairs by phonons. Here the total excitation concentration decreases. (auth)

6335 SUPERCONDUCTING PROPERTIES OF TELLURIUM AT PRESSURES UP TO 260 kbar. Berman, I.V.; Bynzarov, Kurkin, Y.P. (M. V. Lomonosov Moscow State University). Sov. Phys.–Solid State 14: No. 9, 2192-2194 (Mar 1973).

The temperature of the superconducting transition T_k and the critical magnetic fields H_k of tellurium were studied at pressures P up to 260 kbar. In the pressure ranges 40–70, 70–80, and 80–100 kbar, crystal forms of tellurium with dT_k/dp values of (-7.7 ± 1), (0.3 ± 0.1), and (-4.2 ± 1) $.10^{-5}$ deg/bar, respectively, existed. At P = 110 kbar the $T_k(P)$ curve underwent a discontinuity. $DT_k/dP|_{P=110\ kbar} = (1.0 \pm 0.5)$ .. 10^{-5} deg/bar. In the pressure range 180–260 kbar T_k was practically independent of compression. (auth)

6336 EFFECT OF NONMAGNETIC IMPURITIES ON THE SPIN–LATTICE RELAXATION IN SUPERCONDUCTORS WITH AN ELECTRON TRANSITION. Fal'ko, I.I.; Serdyuk, A.D. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Solid State 15: No. 1, 176-179 (July 1973).

The effect of an electron transition on the concentration of the reciprocal of the spin–lattice relaxation time T_1^{-1} of nuclei is studied for superconductors with nonmagnetic impurities. An expression for the correction to T_1^{-1} in a superconducting metal due to an electron transition is obtained by means of the Green's function technique. It is shown that the change in the topology of the Fermi surface of conduction electrons due to the introduction of nonmagnetic impurities gives rise to a nonlinear dependence of the spin–lattice relaxation time on the impurity concentration. This nonlinear dependence of T_1^{-1} can be attributed to the change in the Fermi energy ϵ_F and to the effect of scattering. The correction to T_1^{-1} due to the electron scattering by impurities depends only on the frequency of the electron–impurity collisions, whereas the change in T_1^{-1} related to the change in ϵ_F because of the impurities is different for acceptors and donors. The relative magnitude of the correction to T_1^{-1} depends on the magnitudes of the effective masses. (auth)

6337 EFFECT OF 3d IMPURITIES ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF THE LAYERED COMPOUND $NbSe_2$. Hauser, J.J.; Robbins, M.; DiSalvo, F.J. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 8: No. 3, 1038-1042 (1 Aug 1973).

The transition temperature of $NbSe_2$ as a function of the concentration of such paramagnetic impurities as Fe, Ni, and Co shows a very strong anomaly close to the critical concentration which destroys superconductivity. The strength of the effect in $NbSe_2$ is believed to be caused both by the weak depairing of the impurities and by their nonstatistical distribution resulting from the layered structure. (auth)

6338 TRANSITION TEMPERATURE OF d–f–BAND SUPERCONDUCTORS. Appel, J. (I. Institut für Theoretische Physik, der Universität Hamburg, Germany). Phys. Rev. B 8: No. 3, 1079-1087 (1 Aug 1973).

The theory of Appel and Kohn is used to calculate T_c for a narrow–band superconductor, where the conduction electrons near the Fermi suface have both d and f character. The vertex equations for the symmetrized pair states formed from d and f orbitals are solved in the contact model. The result is used for a parameter study of T_c; one pertinent parameter is the pairing interaction due to phonon exchange between d and f electrons. The experimental situation for La is discussed in terms of the T_c results. (auth)

6339 EFFECT OF IMPURITIES ON SUPERCONDUCTION IN TIN. Mukerjee, A. K.; Chaudhuri, K. D. (Univ. of Delhi). Phys. Lett.; 45A: No. 4, 337-338(8 Oct 1973).

Ultrasonic absorption peaks were observed in a single crystal of tin doped with 0.0093 at % indium. The results are discussed here. (auth)

6340 BEHAVIOR OF TYPE–II SUPERCONDUCTORS AROUND κ_{c_2}. Leplae, L.; Srinivasan, V.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Phys. Lett.; 45A: No. 3, 177-178(24 Sep 1973).

The calculation of the critical κ separating type II/1 superconductors from type II/2 is presented. (auth)

6341 SPIN–LATTICE RELAXATION OF TWO–BAND SUPERCONDUCTOR CONSIDERING INTERBAND ELECTRON SCATTERING ON PHONONS. Serdyuk, A. D.; Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 36: No. 2, 427-429(1973). (In Russian).

The effect of the interband scattering of electrons on the time of spin–lattice relaxation in the superconductor nuclei was investigated. The calculations showed that in the case of large concentrations of nonmagnetic impurities, the two–band character of the $\ln(R_s/R_n) = f(T_c/T)$ curve disappears. (JSR)

6342 NUCLEAR SPIN–LATTICE RELAXATION IN PURE AND IMPURE INDIUM. II. Superconducting State. Williamson, J. D.; MacLaughlin, D. E. (Univ. of California, Riverside). Phys. Rev., B; 8: No. 1, 125-132(1 Jul 1973).

Nuclear spin-lattice relaxation times $T_1(T)$ were measured in superconducting indium and the InGa, InCd, InTl, InHg, and InPb dilute-alloy systems, using a transient nuclear-quadrupole-resonance spectrometer. Local sample heating was identified and its effects minimized. No effects attributable to trapped flux were observed. For fixed T_c/T, T_1 decreases with increasing impurity concentration, which indicates that the anisotropy of the energy gap decreases with decreasing mean free path l. Although the effects of a mean-square anisotropy $\langle a^2 \rangle = 0.005 \pm 0.001$ are essentially averaged out for $l \lesssim \xi_0$ (the pair dimension), the data indicate additional gap broadening in the more concentrated alloys. Lifetime effects associated with thermal-phonon scattering of the quasi particles are insufficient to explain the data, and the additional temperature- and solute-independent broadening is tentatively attributed to a 2% rms energy-gap inhomogeneity. Similar behavior is noted in previous measurements to T_1 in aluminum alloys. $\langle a^2 \rangle = 0.003 \pm 0.001$ is found for pure aluminum and it is suggested that an energy-gap inhomogeneity of about 1% rms determines the density of excited states in concentrated aluminum alloys. (auth)

6343 MICROSCOPIC AND MACROSCOPIC ELECTRONIC PROPERTIES OF THE $AuCu_3$-TYPE ALLOYS: THE $LaSn_3-LaIn_3$ PSEUDOBINARY ALLOY SYSTEM. Toxen, A. M. (IBM Watson Research Center, Yorktown Heights, NY); Gambino, R. J.; Welsh, L. B. Phys. Rev., B; 8: No. 1, 90-97(1 Jul 1973).

The bulk properties of the $LaSn_xIn_{3(1-x)}$ and similar alloy systems display a dramatic, somewhat oscillatory, dependence on the valence-electron concentration. For the $LaSn_xIn_{3(1-x)}$ alloy system the dependence on x of the magnetic susceptibility χ and the local electronic behavior at the La and Sn–In sites were studied using the ^{139}La and ^{119}Sn nuclear-magnetic-resonance Knight shifts K and spin-lattice relaxation times T_1. These results are compared with those for the superconducting transition temperature T_c, the electronic-specific-heat coefficient γ, and the Debye temperature Θ_D. Using McMillan's strong-coupling model, the electron–phonon coupling parameter λ, the bare density of states N(O), and the electron-phonon interaction strength V were calculated from γ and T_c/Θ_D. For the NMR measurements, the Sn NMR properties follow the behavior of the bulk density of states at the Fermi energy, N(O), considerably better than do the La NMR properties suggesting that the local electronic properties of the Sn–In sites play the dominant role in determining T_c. Analysis of the La NMR and χ behavior with x indicates the paramagnetic susceptibility of these alloys arises from the La d band with the La d-orbital contribution accounting for most of the large susceptibility for x near $LaSn_3$ and $LaIn_3$. (auth)

6344 ENERGY-GAP ANISOTROPY AND TOMASCH-EFFECT INVESTIGATIONS INVOLVING SINGLE-CRYSTAL THIN FILMS OF ALUMINUM. Place, J. W. Chapel Hill, NC; Univ. of North Carolina (1973). 132p. University Microfilms Order No. 73-26,228.

Thesis (Ph. D.).

A theory is developed for electron tunneling between superconductors. Emphasis is placed on explaining Tomasch oscillations in terms of interference of "electron-like" and "hole-like" wavefunctions. A summary of related research is presented. Techniques are outlined for vacuum deposition of oriented single-crystal metal films on polished KBr substrates. Fabrication processes are described for junctions of the form (Al)/I/(Single-Crystal Al)/(Single-Crystal Ag). Also included are details of the electronic measurement apparatus and a summary of the cryogenic technology involved. The superconducting energy gaps (2Δ) were observed for Al. An average transition temperature of 1.089°K was found. Tomasch oscillations were observed for the [211] direction, and a Fermi velocity of $v_F = (1.41 \pm 0.05) \times 10^8$ cm./sec. was calculated. (Diss. Abstr. Int., B)

6345 SUPERCONDUCTING ANISOTROPY IN SINGLE CRYSTAL THIN FILMS OF ALUMINUM BY TUNNELING TECHNIQUES. Landry, J. D. Chapel Hill, NC; Univ. of North Carolina (1973). 75p. University Microfilms Order No. 73-26,199.

Thesis (Ph. D.).

Possible interpretations of tunneling selection rules are considered in relationship to the energy gap anisotropy in aluminum. The results of a recent calculation of the energy gap are subjected to these selection rules and predictions of tunneling measurements are thus obtained. Measurements of the energy gap and transition temperature for three new types of aluminum/oxide/aluminum tunnel junctions are reported. The tunnel junctions consisted of epitaxially grown single crystal films with [110], [111], or [211] normal to the plane of the film, a discharge grown aluminum oxide film, and a thin polycrystalline film. The oriented films were 1 to 10 μm thick. This data is combined with measurements on similar junctions of [100] orientation obtained in a previous experiment by Wells. It is shown that these measurements are consistent with those made by Wells and that they support his conclusions. The anisotropy is found to be about one third that predicted by theory. This measured anisotropy in the energy gap is approximately 7.3% of the isotropic energy gap. This anisotropy is too small to clarify the selection rules. As expected, the transition temperatures do not vary with orientation. (Diss. Abstr. Int., B)

6346 SURFACE-IMPEDANCE THEORY FOR PURE TYPE-I SUPERCONDUCTORS IN LARGE STATIC MAGNETIC FIELDS. Sherman, R. D. (California Inst. of Tech., Pasadena). Phys. Rev., B; 8: No. 1, 173-191(1 Jul 1973).

A microscopic nonphenomenological theory for the interaction of electromagnetic radiation with pure Pippard superconductors is presented to explain the changes in surface impedance due to large static magnetic fields. The static magnetic field penetrating the metal's surface creates a momentum-dependent potential. Quasi particles near the Fermi surface find that such a potential strongly modifies their wave function and energy-excitation spectrum. An algorithm is developed that allows surface impedances to be determined despite the difficulties caused by spatial inhomogeneity, anisotropy, and nonlocal electrodynamics. (auth)

6347 THERMOMAGNETIC EFFECTS IN DIRTY TRANSITION-METAL SUPERCONDUCTORS NEAR THE UPPER CRITICAL FIELD. Kumar, P.; Gupta, S. N. (Univ. of Roorkee, India). Phys. Rev., B; 8: No. 1, 168-172(1 Jul 1973).

Using the Suhl, Matthias, and Walker two-band model, the thermomagnetic effects were studied in dirty type-II transition-metal (TM) superconductors, in flux-flow state, immediately below the upper critical field and in the temperature region $T_{c2}^{(0)} < T < T_{c2}(=T_c)$. It is found that there is an anomalous increase of d-band thermomagnetic effects in dirty TM superconductors below H_{c2}, arising from the existence of interband impurity scattering. This behavior is analogous to the d-band Hall angle, recently investigated by Chow. For pure niobium, the results are exactly reducible to those of Caroli et al. for a one-d-band superconductor. (auth)

6348 SUPERCONDUCTIVITY OF COLD-DEPOSITED FILMS OF ALLOYS OF GERMANIUM WITH PLATINUM-GROUP ELEMENTS. Alekseevskii, N. E.; Zakosarenko, V. M. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 53-55(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 94-98(20 Jul 1973).

Superconducting modifications of alloys of germanium with platinum-group elements were found in the form of cold-deposited films of Ge–Pt and Ge–Pd alloys. The Ge–Pd system is used to investigate the dependence of the critical temperature on the composition and to measure the critical magnitude. (auth)

6349 HIGH-TEMPERATURE SUPERCONDUCTING BEHAVIOUR IN PbTe-Pb SYSTEM. Lasbley, A.; Granger, R.; Rolland, S. (INSA, Rennes, France). Solid State Commun.; 13: No. 8, 1045-1048(15 Oct 1973).

A strongly field dependent diamagnetic susceptibility has been observed in PbTe up to temperatures reaching 20°K. This could be explained through anomalous superconductivity of lead precipitates in subgrain boundaries of PbTe crystals. (auth).

6350 FORCE-FREE MAGNETIC FIELDS IN Pb–50 AT. % In. Walmsley, D. G.; Timms, W. W. (New Univ. of Ulster, Coleraine, Northern Ireland). J. Phys., F (London); 3: No. 10, L203-L205(Oct 1973).

Behavior previously detected by Walmsley (J. Phys. F. Metal Phys.; 2:510(1972) and 2:529(1972)) in samples of a Pb–Tl alloy is again observed in a Pb–In alloy under significantly different experimental conditions. It is suggested that this behavior is typical of all nearly reversible superconductors when currents and magnetic fields are applied in parallel geometry. (auth)

6351 CALCULATION OF PRESSURE DEPENDENCE OF SUPERCONDUCTING TRANSITION TEMPERATURE T_c IN NIOBIUM AND VANADIUM. Evans, R.; Ratti, V. K.; Cyorffy, B. L. (Univ. of Bristol, Eng.). J. Phys., F (London); 3: No. 10, L199-L202(Oct 1973).

The electronic part, η, of the electron-phonon mass enhancement is calculated at normal and reduced volumes for Nb and V. It is found that η increases rapidly with decreasing volume and the coefficients d ln η/d ln V are in good agreement with empirical analyses of the pressure dependence of T_c in these transition metals. (auth)

6352 THEORETICAL STUDY OF THE INFLUENCE OF MAGNETIC IMPURITIES IN SUPERCONDUCTORS. Chaba, A. N. Waterloo, Can.; Univ. of Waterloo (1972). Univ. of Waterloo Library.

Thesis (Ph. D.).

Using the Green's function given by Shiba or Rusinov, several properties of superconducting alloys containing paramagnetic impurities and having local states within the gap were calculated. The density of states and the conductance curves were calculated and the latter were compared with experiment. It is found that the agreement is satisfactory. At temperatures equal to zero, near zero, and near T_c, the analytic expressions for the order parameter and various thermal and electromagnetic properties are given. For various values of ϵ_0 (the normalized position of a local state with a single impurity), the dependence of the zero temperature order parameter and the zero temperature critical field and zero temperature penetration depth on the inverse spin-flip collision time are computed. Further, for various values of ϵ_0, the impurity-concentration dependence of the zero temperature order parameter, the transition temperature, the zero temperature critical field and the zero temperature penetration depth are computed. For Shiba–Rusinov model as well as for Zittartz model, the jump in specific heat was computed as a function of reduced critical temperature and also as a function of concentration. (Diss. Abstr. Int., B)

6353 SVERKHPROVODYASHCHIE SPLAVY I SOEDINENIYA. Trudy VI Vsesoyuznogo Soveshchaniya po Probleme Sverkhprovodyashchikh Materialov. (Problems of Superconducting Materials. 6th All-Union Conference Held at Moscow, USSR, May 26–28, 1969). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). 205p. (CONF-690573-).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969).

Twenty-nine papers are included. Separate abstracts were prepared for each. (MHR)

For abstracts of individual papers see: 6354–6380, 6390, and 6391.

6354 ATTEMPT AT THE PROGNOSIS OF THE TRANSITION TEMPERATURE TO THE SUPERCONDUCTING STATE OF SOME METALLIC COMPOUNDS BY COMPUTER METHODS. Savitskii, E. M.; Devingtal, Yu. V.; Gribulya, V. B. pp 7-20 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The results of the prognosis of compounds of the A_3B type and their properties, realized by means of the EVM data on the electron structure of the atoms of the elements were examined. The work was done by use of the method of form identification. An analysis is given of the interaction of V, Nb, and Ta with elements of the periodic system. Examples were given of the prognosis of the order of magnitude T_c for compounds of the A_3B type in comparison with experimental data. On the basis of these data the possibility of predicting the properties of materials, based on the EVM irradiation method, was shown. (tr-auth)

6355 ELECTRON CHARACTERISTICS OF SPRAYED ALLOYS OF VANADIUM WITH GALLIUM. Golovashkin, A. I.; Levchenko, I. S.; Motulevich, G. P. pp 20-29 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

A new method was developed for the production of superconducting compounds of V with Ga having high critical parameters: transition temperature T_c and current density i_c almost independent of the composition of the alloy in a wide interval of concentrations. The following electron characteristics of the alloys obtained were measured by optical methods: concentration of the conductivity electrons, total area of the Fermi surface, mean velocity of electrons on the Fermi surface, effective frequency of electron collisions, Fourier components of the pseudopotential. Some correlation was established between T_c on the one hand and the concentration of the conductivity electrons and the frequency of the electron–phonon collisions on the other. (tr-auth)

6356 PREPARATION OF DIFFUSION LAYERS OF V_3Ga COMPOUNDS ON VANADIUM SUPPORTS. Kukharchuk, V. G.; Moiseev, A. I.; Ugol'nikova, T. A. pp 29-34 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The conditions for the preparation of superconducting layers of V_3Ga on V supports during its fabrication in liquid Ga at temperatures from 100 to 500°C and with use of annealing at temperatures from 800 to 1100°C were investigated. The samples were examined by radiographic and metallographic analyses. The temperature-time conditions for the formations of the diffusion layers of V_3Ga were determined. On samples gallinated at 400°C, an unknown V–Ga phase was detected. Its composition and structure were not determined. The maximum temperature for the transition to the superconducting state of V_3Ga layers obtained by the diffusion method was 15.2°K. (tr-auth)

6357 * STRUCTURE AND PROPERTIES OF ALLOYS OF THE V_3Si–V_3Ga–V_3Al SYSTEM. Savitskii, E. M.; Efimov, Yu. V. pp 34-42 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

By means of microscopic and x-ray analysis and measurements of the microhardness and transition temperature to the superconducting state, the structure and properties of the alloy of the V_3Si–V_3Ga–V_3Al cross section of the V–Si–Ga–Al system were studied. The distribution of the phase region of this cross section was studied at temperatures near the solidus and after annealing at 800°C. The compound V_3Al was not detected in alloys cast and annealed at 800°C. New pseudoternary compounds were also not found. The measurement of T_c of the pseudoternary alloys in dependence on their properties obeyed the basic law of physical chemical analysis. The solid solution based on V, enriched in Al with body-centered cubic lattice was not superconducting at temperatures higher than 4.2°K. (tr-auth)

6358 MOESSBAUER EFFECT IN Nb_3Sn IN DEPENDENCE ON THE HEAT TREATMENT. Gruzin, P. L.; Bychkov, Yu. F.; Evstyukhina, I. A.; Kruglov, V. S.; Nikolaev, I. N. pp 42-47 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

For the superconducting compound Nb_3Sn the so-called degradation effect–the substantial decrease of T_c at increase of the temperature of annealing or sintering up to 2000°C–was reported. In the present study the effect of the heat treatment of Nb_3Sn in a vacuum on the parameters of the nuclear γ resonance was investigated. With increase of the annealing temperature a significant decrease of the width of the nuclear γ resonance lines and isomeric displacement was observed. A tendency to decrease the absorption probability also took place. Contraction of the nuclear γ resonance lines is connected with the increase of the degree of ordering of the structure of Nb_3Sn. The possibility of determining the degree of ordering with respect to the absorption probability for different states was shown if the degree of ordering and the absorption probability are known for two other states. With increase of the temperature of the heat treatment a change of the density of the 5S electrons in the Sn nucleus was observed. It was shown that the nuclear γ resonance method is very sensitive to the presence in the Nb_3Sn of other phases containing Sn. (tr-auth)

6359 TEMPERATURE CONDITIONS FOR THE PRECIPITATION OF Nb_3Sn FROM THE GASEOUS STATE. Ugol'nikova, T. A.; Moiseev, A. I. pp 48-54 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The process of the precipitation of Nb_3Sn by reduction of $NbCl_5$ and $SnCl_4$ with water on supports heated to different temperatures and with different compositions of the steam–gas mixture was investigated. It was established that the basic condition for the preparation of the single phase precipitate Nb_3Sn from the chlorides is the temperature of the support and not the composition of the steam–gas mixture. It was shown that the temperature of the superconducting transition of Nb_3Sn, precipitated on Pt with constant composition of the steam–gas mixture, changes in dependence on the temperature of the support from 15.7 to 18.1°K and has a maximum value at a temperature of 950°C. (tr-auth)

6360 PREPARATION AND INVESTIGATION OF COATINGS OF Nb_3Sn ON SUPPORTS OF DIFFERENT METALS AND ALLOYS. Savitskii, E. M.; Baron, V. V.; Mikhailov, B. P. pp 55-59 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

A process for the preparation of coatings containing Nb and Nb_3Sn on supports of different metals and alloys was developed. Among the supports studied were Cu, Mo, and steel. The structure and superconducting properties of the coatings were investigated. The temperature transition to the superconducting state is equal to ~17.5 to 17.8°K. (tr-auth)

6361 PRODUCTION AND INVESTIGATION OF TAPES WITH COATINGS OF Nb_3Sn. Enman, V. K.; Krainskii, I. S.; Baranov, L. A.; Konovalov, N. T. pp 60-63 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

A device for the continuous heat treatment of Nb tapes in tin baths was constructed. Investigations were carried out in this device on the effect of the temperature and velocity of the process on the critical parameters of the tape. Conclusions were made on the advisability of supplementary heat treatment of tapes having coatings of Nb_3Sn + Sn. (tr-auth)

6362 CONCENTRATION OF OXYGEN IN SUPERCONDUCTING COMPOUNDS BASED ON VANADIUM AND NIOBIUM. Burtsev, V. T.; Efimov, Yu. B. pp 63-69 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The concentration of oxygen in superconducting refractory compounds Nb_3Sn, V_3Ga, V_3Si and alloys of V with 25 at. % Al was investigated by the method of vacuum fusion. The selection of the supplementary metallic baths was made. The kinetics of the removal of carbon monoxide in the Pt-C bath was investigated. The sorption rate of the condensate was evaluated by analysis of V_3Si. The analysis of the compounds follows the procedure: (1) in melts of Ni with 25 wt. % Fe with 1:10 dilution in steel capsule with admixtures of Sn up to 10 to 12 wt. % of the weight of the tapes at a temperature of 1650°C and an extraction time of 7 min; the weight of the sample is 0.3 to 0.4 g and 4 pieces in quantity; (2) in Pt melts with 1:10 dilution at a temperature of 1920°C and extraction time of 7 min; the weight of the samples is 0.1 to 0.15 g and the number of pieces is 5 to 6. (tr-auth)

6363 PHASE DIAGRAM OF THE NIOBIUM-GALLIUM SYSTEM. Pan, V. M.; Latysheva, V. I. pp 70-77 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The phase diagram of the equilibrium of the Nb-Ga system was constructed. The existence of six compounds, stable up to room temperature, was detected: Nb_3Ga, Nb_2Ga_3, Nb_3Ga_4, Nb_4Ga_5, Nb_3Ga_{13}, $NbGa_3$, and one high temperature compound $NbGa_4$. The compound $NbGa_3$ was formed by a peritectic reaction at a temperature of 1770°C. The compound Nb_3Ga_2 is congruent melting. Its fusion temperature is 1870°C. The compounds Nb_3Ga_4, Nb_4Ga_5, $NbGa_4$, and $NbGa_3$ were formed by peritectic reactions at temperatures of 1560, 1310, 1285, and 1120°C, respectively. The temperature of the decomposition of the compound $NbGa_4$ is 1205°C. The compound Nb_3Ga_{13} was formed by peritectic reaction at 1260°C. The measurements of the critical temperatures of the Nb-Ga alloys were confirmed by earlier published data on the existence in this system of alloys, beginning to transfer to the superconducting state at 19.85°K. The critical temperature of the compound Nb_3Ga of the superconducting structure is 16°K. (tr-auth)

6364 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF ALLOYS OF THE VANADIUM-TANTALUM SYSTEM. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V.; Model, M. S. pp 78-86 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

By microscopic, x-ray, x-ray spectral, and thermal analysis methods, and by measurement of the microhardness and transition temperature in the superconducting state the conversion to the solid state was made more precise and composition-property diagrams of alloys of the V-Ta system were constructed. The compound TaV_2 with structure of the $MgZn_2$ type was formed at 1420° and ~ 33 at. % Ta. At 1125° and 29 at. % Ta this phase eutectoidly decomposes into the solid solution with body-centered cubic lattice and phase with structure of the $MgCu_2$ type. The latter was also formed by peritectic reaction at 1280° and 37 at. % Ta. This is homogeneous at 800° in the interval 32 to 39.5 at. % Ta. T_c of the high temperature phase with hexagonal structure of the $MgZn_2$ type is 10°K. (tr-auth)

6365 SPECIFIC HEAT OF ALLOYS OF THE NIOBIUM-TITANIUM SYSTEM NEAR THE TEMPERATURE OF TRANSITION TO THE SUPERCONDUCTING STATE. Savitskii, E. M.; Sukharevskii, B. Ya.; Baron, V. V.; Alapina, A. V.; Bychkova, M. I.; Dushechkin, Yu. A.; Shchetkin, I. S.; Kharchenko, M. N. pp 87-101 of Sverkhprovodyashchie splavy i soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1959). See CONF-690573-.

The temperature dependence of the specific heat of the Nb-Ti system in the region of the superconducting transition was studied. The concentration dependence of the critical temperatures, the transition widths, the discontinuity of the specific heat at the transition, Debye temperatures, and the density of states at the Fermi surface were obtained. (tr-auth)

6366 EFFECT OF THE HEAT TREATMENT ON THE CRITICAL POINTS OF BINARY ALLOYS OF NIOBIUM WITH ZIRCONIUM AND TITANIUM. Skvortsova, I. L.; Tararaeva, E. M.; Schmidt, V. V.; Raevskii, I. I. pp 101-111 of Sverkhprovodyashchie splavy i soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The dependence of the critical point on the strength of the external magnetic field was studied for the alloys Nb-Zr and Nb-Ti of different concentrations and after different annealing temperatures. The experimental data were combined with existing concepts on the course of the transport point to rigid superconductors. This made conclusions possible. The transition in the normal state of the alloy Nb-5 at. % Zr occurs as a result of the break of the electron pair during its attainment of the critical rate. The destruction of the superconductivity in Nb with 55 and 75 at. % Zr and 55 and 80 at. % Ti originates because of onset of motion of the superconducting vortex. A direct connection was obtained between the annealing temperature of these alloys and the strength of the immobilization of the superconducting vortices on macroinhomogeneities isolated in the heat treatment. (tr-auth)

6367 EFFECT OF ALUMINUM ON THE SUPERCONDUCTING AND MECHANICAL PROPERTIES OF NIOBIUM AND TITANIUM ALLOYS. Savitskii, E. M.; Baron, V. V.; Frolov, V. A.; Kozlova, N. D. pp 111-115 of Sverkhprovodyashchie splavy i soedineniya. Savitskii, E. M. (ed.). Moscow, Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

Alloys of the Nb-Ti-Al system were investigated in the range of β solid solution, adjacent to the Nb-Ti side with constant ration of Ti/Nb = 45/55 and with Al concentration up to 7.2 wt. %. The introduction of Al decreases the temperature of the transition to the superconducting state of the alloys both in the cast and in the annealed state. The critical current of the alloys also decreases. The strength of the alloy on the introduction of Al is increased and the ductility changes little. (tr-auth)

6368 TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTANT SUPERCONDUCTING ALLOYS OF Ti-Nb AND Ti-Nb-Zr, SUBJECTED TO TREATMENT WITH HYDROSTATIC PRESSURE. Kirshenina, I. I.; Fedotov, L. N. pp 115-121 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

Treatment with hydrostatic pressures up to 15 kbar leads to an increase of the temperature of the superconducting transition T_c reached in some Ti-Nb alloys at 1 to 1.3°K (10 to 15%). The addition of 0.4% Fe to the Ti-Nb-Zr alloy of the 35BT type leads to an increase of T_c to 1.4 to 1.6°K. In the alloys studied a relative or zero coefficient of resistance at $T > T_c$, indicative of semiconductor character of conductivity, was observed. (tr-auth)

6369 MAGNETIZATION OF MONOCRYSTALS OF NIOBIUM AND ZIRCONIUM. Savitskii, E. M.; Baron, V. V.; Myzenkova, L. F.; Martynova, L. F. pp 122-125 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The magnetization curves of monocrystalline samples of Nb with 5% Zr, having different crystallographic axial orientations (at 4.2°K), were plotted. Anisotropy of the critical magnetic field, the residual magnetic moment, and the maximum diamagnetic moment was detected. (tr-auth)

6370 MECHANISM OF HEAT TRANSFER IN SOLID SOLUTIONS OF THE Nb-Zr SYSTEM AT LOW TEMPERATURES. Savitskii, E. M.; Sukharevskii, B. Ya.; Baron, V. V.; Anders, E. E.; Frolov, V. A.; Mal'chuzhenko, K. V.; Shestakova, I. V. pp 125-134 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

Studies were made on the heat transfer and electrical conductivity of solid solutions of alloys of the Nb-Zr system with concentrations of 1.67, 5.05, and 9.84 at. % Zr in the region of the transition to the superconducting state. The lattice components of the heat transfer for alloy samples with 5.05 and 9.84 at. % Zr were determined. Data were introduced which made it possible to assume that the lattice heat transfer is determined by the scattering of phonons by electrons. (tr-auth)

6371 PHASE CONVERSION IN LIGHTLY ALLOYED ZIRCONIUM ALLOYS BY THE METHOD OF THE SUPERCONDUCTING TRANSITION. Bychkov, Yu. F.; Zuev, M. T.; Cherkasov, N. A. pp 135-139 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The phase conversion, occurring during heat treatment, can be studied by means of the electrical resistance at He temperature if the superconducting properties of the matrix and precipitated phase are different. During investigation of the Zr-2.5% Nb alloy, having a nonsuperconducting matrix at 4.2°K and a superconducting β phase it was shown that tempering of the two-phase alloy at 450 and 550°C leads to a regular change of the residual resistance and the temperature of the superconducting transition. The changes of these characteristics were compared with the radiographic obtained changes of the phase composition and of the dimensions of the dispersed precipitation of the β and ω phases. The method has high sensitivity to the superconducting precipitations; their distributions also affect the superconducting transition. (tr-auth)

6372 EFFECT OF RHODIUM ON THE SUPERCONDUCTING PROPERTIES OF ZIRCONIUM AND SOME OF ITS ALLOYS. Baranov, I. A.; Bychkov, Yu. F.; Korzhov, V. P.; Mal'tsev, V. A.; Slavgorodskii, M. P.; Shmulevich, R. S. pp 140-147 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The effect of the dispersed precipitation of the phases having a much higher critical temperature than the matrix on the critical current was studied. The addition of Rh leads to an increase of T_c of Zr up to 6 to 7°K during the formation of body-centered cubic solid solutions and up to 11 to 12°K during the formation of Zr_3Rh. The measurement of the critical current was carried out on the ternary alloys Zr-Nb-Rh and Zr-Mo-Rh. After annealing at 450°C, when only the α phase was precipitated, a significant increase of the critical current occurred. After annealing at 550°C, when together with a very coarse precipitation of the α phase precipitation of the compound Zr_3Rh with a very high value of T_c appeared, the critical current was substantially lower. The results indicated the large positive effects on the critical current of dispersed precipitations nonsuperconducting at 4.2°K in superconducting deformation of the matrix. (tr-auth)

6373 EFFECT OF A SUPER LARGE COOLING RATE ON THE SUPERCONDUCTIVITY OF LEAD-BISMUTH ALLOYS. Salli, I. V.; Shvets, V. S.; Dzenzerskii, V. A. pp 147-150 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

Experimental data obtained by study of the effect of the very large cooling rate (10^3 to 10^6°C in 1 sec) on the conductivity of Pb alloys with Bi additions of 15, 20, 25, 30, 35, 40, and 56.5 at.% were reported. The normally cooled samples (cooled in air) confirm the data from the literature on the dependence of the critical temperature of transition to the superconducting state on the concentration of Bi in the alloy. In the very rapidly cooled alloys T_c depends on the time of exposure of the sample at room temperature between the processes of preparation and measurement. (tr-auth)

6374 PHYSICAL, MECHANICAL, AND X-RAY STRUCTURAL CHANGES OF THE SUPERCONDUCTING WIRES OF THE ALLOY 60T IN DEPENDENCE ON THE DEGREE OF DEFORMATION AND THE DURATION OF THE VACUUM ANNEALING. Baikov, A. I.; Gorbacheva, L. S.; Alimova, R. N.; Sergeev, N. N.; Klein, G. A.; Goncharova, V. V.; Mikhailov, S. M.; Litvinova, I. I. pp 151-156 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

In order to establish the optimum working conditions during the preparation of wires from 60T alloy a series of experiments was carried out on the establishment of the effect of intervening annealing and heating in the process of drawing of wires on the technological, electrical, and superconducting properties of the wire. It was established that the use of heating during the drawing of the wires from the 60T alloy increases its technological properties and guarantees the preparation of long pieces. The higher the degree of reduction the sharper the electrical resistance curve is reduced. In the processes of annealing and deformation a change in the structure of the wire of 60T alloy occurs (appearance of new lines and change of the texture and grain size). The process of collective recrystallization begins at the annealing temperature of 700°C for wires with diameters of 1 and 0.5 mm and 600°C for wires with diameter of 0.3 mm. (tr-auth)

6375 PROPERTIES OF THE TERNARY ALLOY SS-2 IN THE PROCESS OF DEFORMATION AND VACUUM ANNEALING. Baikov, A. I.; Klein, G. A.; Gorbacheva, L. S.; Alimova, R. N.; Mikhailov, S. M.; Litvinova, I. I.; Berezin, R. G. pp 157-160 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

A series of experiments was carried out on the establishment of the effect of intervening annealing on the technological, mechanical, electrical, and structural properties of wires of the SS-2 alloy, which refers to the Nb-Ti-Zr system. From the data obtained it follows that the use of an intervening annealing is connected with the embrittlement of the SS-2 wire to a greater degree than a smaller diameter of the wire and a higher annealing temperature. X-ray structural analysis indicates that the change of the phase composition of the alloy under the given conditions of annealing does not occur. All the samples have the structure of the β solid solution with lattice parameters a = 3.25 kX. The examination of the Debye diagram, obtained with annealed samples for wires of all diameters, showed that the temperature of the onset of the recrystallization for wires of all diameters is identical and is 700°C. Subsequent annealing leads to enlargement of the grain; a particularly strong growth of the grain is observed at annealing temperatures of 1000 and 1100°C. (tr-auth)

6376 PROPERTIES OF THE SUPERCONDUCTING ALLOY 35BT. Kadykova, G. N.; Molotilov, B. V.; Prokoshin, A. F.; Sergeev, I. P.; Fedotov, L. N. pp 160-166 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The structure, electrical resistance, and thermal expansion of the superconducting alloy 35BT, containing nominally 35% Nb, Ti, and some addition of Zr, was investigated in the condition after cold deformation, annealing, and also during heating. The highest current density $I_c = 1 \times 10^5$ amp/cm^2 in a transverse magnetic field of 30 koersted is reached after cold deformation and annealing at 450° for 4 hrs. In the structure of alloys in this state precipitation of the α phase with transverse dimensions of ~300 Å was observed. On the I_c (H) curve of the samples in the state after cold deformation and after annealing at 200 to 300° peaks were observed connected with the presence in the structure of the alloys of particles of the ω phase. (tr-auth)

6377 MEASUREMENT OF THE TRANSITION TEMPERATURE TO THE SUPERCONDUCTING STATE OF ALLOYS WITH A VARIABLE COMPOSITION USING AS AN EXAMPLE THE NIOBIUM-TANTALUM SYSTEM. Savitskii, E. M.; Baron, V. V.; Gindina, S. D. pp 166-170 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

Methods were developed for the measurement of the transition temperature to the superconducting state in alloys of variable composition. The samples were prepared by the method of zone electron beam fusion. The composition of the sample varies from 100% Ta in one zone of the sample to 20% Ta in another. On one sample of variable composition the transition temperatures of alloys of the Nb-Ta system were measured. The values of the electrical resistance of all alloys of this system were also obtained at 300 and 77°K. (tr-auth)

6378 APPARATUS FOR MEASUREMENT OF THE TRANSITION TEMPERATURE OF SUPERCONDUCTING SAMPLES BY THE INDUCTION METHOD. Kozlova, N. D.; Baron, V. V.; Savitskii, E. M. pp 170-174 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

A simple and reliable circuit for the measurement of the transition temperature to the superconducting state of samples of arbitrary form was described. The sensitivity to the superconducting phase is about 10 v/g. The circuit makes it possible to study the

phase composition of samples with quantity of the superconducting phase of no less than 5×10^{-4} g. (tr-auth)

6379 METHOD FOR THE MEASUREMENT OF THE LONGITUDINAL CRITICAL CURRENT IN SUPERCONDUCTING ALLOYS. Vereshchagin, V. G.; Karasik, V. R.; Kurganov, G. B. pp 175-177 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

For investigation of the dependence of the critical current on the longitudinal magnetic field a methodic difficulty arises, connected with three circumstances: necessity of arranging the contact in the strong magnetic field, a large size of the current density ($\sim 10^6$ amp/cm^2), and harmful effect of transverse constituents of the magnetic field. These difficulties can be overcome by means of a holder of special construction and use of ultrasonic tinning. Contacts having a resistance of $\approx 10^{-8}$ ohm in a magnetic field of ~50 koersted were obtained. This method was used for the measurement of the transverse current in samples of superconductors. (tr-auth)

6380 STRUCTURE AND PROPERTIES OF ALLOYS OF THE $V_3Si-V_3Ga-V_3Ge$ SYSTEM. Savitskii, E. M.; Efimov, Yu. V.; Kozlova, N. D. pp 188-196 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The structure and some properties of alloys in the cast condition and the state annealed at 800°C of the pseudoternary system $V_3Si-V_3Ga-V_3Ge$ were studied. On the basis of the experimental data obtained by means of simplet lattice method composition diagrams of T_c (microhardness and crystalline lattice) of these alloys were calculated and constructed. Different experimental and calculated data are at the limit of error of the tests. The change of T_c and the crystalline lattice of the solid solution V_3(Gi, Ga, Ge) has the same sign of deviation from the linear dependence on the composition; however the magnitudes of the deviations and the maximum deviation of displacement relative to each other are proportional to the concentrations. The maximum microhardness occurs in the area of alloys with comparatively low T_c. (tr-auth)

Equipment and Devices

Refer also to abstracts 5704, 5706, 6632, and 7362.

6381 (BNL-18281) MICROSCOPIC THEORY FOR THE FLUCTUATION-DRIVEN PHASE TRANSITION IN WEAK ITINERANT MAGNETS. Murata, K. K. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1973. 10p. (CONF-731104-3). Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

The microscopic basis for a recent phenomenological theory for the thermodynamics near T_c of weak itinerant magnets is presented. Calculation of dynamic renormalization effects within paramagnon theory justifies the previous assumption of weakly temperature dependent Ginsburg-Landau α and β coefficients. The cutoff on the fluctuation phase space is found to go as $q_m \sim (T_c)^{1/2}$ rather than the usual inverse coherence length. In spite of the phase space reduction, as $T_c \to 0$, the phenomenological description becomes exact in a temperature region of order T_c. However, it is found that the α and β coefficients must be determined phenomenologically since no small parameter enters the calculation of their overall magnitude. (auth)

6382 (LBL-1855) CHARACTERIZATION OF METAL OXIDE TUNNELING BARRIERS. McBride, D. E. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.) Sep 1973. Contract W-7405-eng-48. 87p. Dep. NTIS $6.50.

Thesis.

A method of characterizing the barrier in a metal insulator metal tunneling junction on the basis of experimental current-voltage curves and a simple theoretical model was developed. It is possible to determine unambiguously the barrier height ϕ and barrier thickness S by, first, measuring the quantity $S\phi^{1/2}$ from the slope of the Fowler-Nordheim plot. Then experimental data are compared with a family of current-voltage curves calculated for various pairs of S and ϕ with $S\phi^{1/2}$ fixed at the measured value, and the pair which gives the best fit is determined. This procedure has been tested on the best understood tunneling barrier, that grown thermally on an aluminum film, and is found to give a barrier height of about 2.6 eV, in good agreement with independent measurements. This method also enables one to construct a qualitative description of the tunneling barrier which provides a context for the quantitative measurements. The barrier seems adequately described by a trapezoidal model, often with unequal sides but of nearly uniform height over the junction area. Although the barrier thickness is not uniform, the variation occurs on a microscopic scale in a well-prepared junction, and the magnitude of the variation is a small fraction of the mean thickness. The method was also used to measure parameters of barriers grown thermally on chromium, thin film vanadium, and bulk vanadium, and barrier heights of 0.6 eV, 0.1 eV, and 0.2 eV respectively were obtained. The technique is a convenient one for the analysis of data from an experiment, and the results it gives are unambiguous, consistent, and provide a sensitive measurement of the characteristics of the barrier. (auth)

6383 (RL-73-92) HYPOTHESIS CONCERNING THE TRAINING PHENOMENON OBSERVED IN SUPERCONDUCTING MAGNETS. Evans, D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Aug 1973. 15p.

The basis of the proposal is that the phenomena of serrated yielding in metals strained at low temperatures and the "training" behavior observed in superconducting coils are related. This requires that at some point in the coil assembly the superconductor be subjected to a strain beyond the linear elastic limit. (auth)

6384 QUANTUM INTERFERENCE EFFECTS IN STATISTICAL SYSTEMS OF JOSEPHSON JUNCTIONS IN THE PRESENCE OF FLUCTUATIONS. Yurchenko, I.I.; Kartavtsev, V.S.; Matveev, V.I.; Dmitrenko, I.M. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Solid State 15: No. 1, 244-245 (July 1973).

An experimental study is reported of the interference effects in systems consisting of a large number of superconducting particles coupled by the Josephson forces, the coupling energy being comparable with the energy of fluctuations, as in the case of a single junction. The reduction in the coupling energy to the fluctuation level should increase the responsivity of the system to external microwave fields, by analogy with the case of a single junction. Therefore, it would be interesting to consider the possibility of using such systems as sensitive microwave detectors. The experiments were carried out on a niobium powder consisting of particles about 10 μ in diameter. (auth)

6385 SPACER MEANS FOR A SUPERCONDUCTIVE ELECTRICAL CABLE. Schmidt, F. (to Siemens Aktiegesellschaft). US Patent 3,758,701. 11 Sep 1973. Priority date 17 Aug 1971, F. R. Germany. 6p.

An electrical cable is described which includes an electrical superconductor immersed in liquid coolant. The cable includes inner and outer tubular conduits with the inner conduit enclosing the electrical superconductor and the liquid coolant. At least two support elements are positioned between the conduits to provide support for the adjacent region of the inner conduit to maintain it in spaced coaxial relation within the outer conduit. Each support element includes a slender arch-shaped member having axially spaced first and second ends and an apex intermediate the ends spaced radially therefrom. The ends of each support element are fixedly connected with one of the conduits and a sliding connection is provided between its apex and the other of the conduits. At least one annular strut connects the support elements so that they are braced together. (auth)

6386 ELECTROMAGNETIC PROPERTIES OF POINT-CONTACT JOSEPHSON-JUNCTION ARRAYS. Clark, T. D. (Cornell Univ., Ithaca, NY). Phys. Rev., B; 8: No. 1, 137-162 (1 Jul 1973).

The interaction of point-contact Josephson-junction arrays with electromagnetic fields, both self-generated and externally applied, is considered. Data are presented which suggest that such point-contact arrays can enter a "correlated" state in which the voltage drops at each of the junctions across the array equal the Josephson value $\hbar\omega_0/2e$ or some multiple or submultiple of this value. The use of these and other types of weak-link arrays as radiation detectors is discussed. (auth)

6387 LOW TEMPERATURE SAMPLE HOLDER FOR ROTATING A CRYSTAL UNDER TENSION IN A SUPERCONDUCTING SOLENOID. Angadi, M. A.; Britton, D. E.; Fawcett, E. (Univ. of Toronto). J. Phys., E (London); 6: No. 11, 1086-1087 (Nov 1973).

A sample holder is described for rotating a crystal about its axis under tension up to about 5 kg at liquid helium temperature and in fields of up to 100 kOe provided by a superconducting solenoid of 44.5 mm bore. (auth)

6388 COOLING OF LARGE ENTHALPY SYSTEMS BY METALLIC CONTACT IN VACUUM. Elsner, A.; Bitter, W.; Jaeckel, H. J.; Rau, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Cryogenics; 13: No. 10, 607-609 (Oct 1973).

The heat transfer across metallic contacts in vacuum is studied

in the temperature range from 300 to 6 K. An enthalpy of 35 MJ is removed from two large copper rings by a cooling device built into a levitated superconducting quadruple plasma physics device. Above 50 K the contact conductance has a value of 3.5 W per K^{-1}, which is found to be independent of temperature. Between 5.5 and 20 K the conductance varies as shown by the following empirical relation: $C(WK^{-1}) = 4 \times 10^{-4} \times T^{2.5}$. (auth)

6389 EFFECT OF MAGNETIC FIELD ON THE THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF DIFFERENT MATERIALS. Fevrier, A.; Morize, D. (CEN de Saclay, Gif-sur-Yvette, France). Cryogenics; 13: No. 10, 603-606 (Oct 1973).

In impregnated superconducting coils it is assumed that copper heat sinks extract the heat produced by ac losses. For this type of cooling the effect of magnetic field on the Wiedemann–Franz law was studied for copper of different purities. The effect of magnetic field on the thermal conductivity tensor of resin with 2% silica gel and of a composite interlayer of an impregnated coil were considered. (auth)

6390 SOLENOID WITH COMPENSATING COIL WITH Hc = 52 kOe. Krainskii, I. S.; Shchegolev, I. F.; Rubtsov, V. A. pp 177-185 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The results of the development and experimental verification of a superconducting solenoid with high homogeneity of the magnetic field were reported. The different types of superconductor–superconductor contacts were studied. The minimum resistance of the clamp contact was 6.9×10^{-9} ohm. The superconducting welded contact with high critical parameters was obtained. The stability of the magnetic field of the solenoid with welded contact is no worse than 8 hrs. (tr-auth)

6391 METER FOR THE INTENSITY OF THE MAGNETIC FIELD OF SOLENOIDS BY THE NMR METHOD. Karimov, Yu. S.; Krainskii, I. S. pp 186-188 of Sverkhprovodyashchie Splavy i Soedineniya. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

From sixth all-union conference on the problems of superconducting materials; Moscow, USSR (26 May 1969). See CONF-690573-.

The circuit for a meter for the intensity of the magnetic field by the NMR method, assembled from standard devices for fields higher than 25 k oersted, was described. The nonstandard element of the circuit is the transducer, and its construction details were examined. The precision of the measurement of the intensity of the magnetic field is 10^{-5}. (tr-auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 6135, 6449, 6752, 6774, and 7198.

6392 (AREAEE-166) EXPERIMENTAL INVESTIGATION OF SPACE-ENERGY DISTRIBUTIONS OF SLOW NEUTRONS IN WATER NEAR PLANE ABSORBER. Hussein, A.; El-Konsol, S.; Novikov, A.; Zakharkin, I.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 43p. Dep. NTIS (U.S. Sales Only) $4.25.

A mechanical neutron time-of-flight spectrometer was used to measure neutron space–energy distributions near a cadmium plate, of 1 mm thickness, immersed in a water-filled tank. The ET-RR-1 reactor served as a neutron source. Measurements of thermal and resonance neutron distributions, using activation technique, were performed in the tank with and without the cadmium plate. Measurements were made of the neutron spectra emerging normally from the plate ($\mu = +1$). The spectra were measured at the distances 0, 0.25, 0.5, 1.5, 3.0, and 5.0 cm from the plate surface. An exit tube was used to extract the neutron beam from the region of measurement. The required corrections were introduced to the measured spectra. The measurements are discussed and analyzed in the framework of the neutron temperature approximation. An appreciable softening effect is observed for the measured neutron spectra of $\mu = +1$. The temperature for the spectrum at a distance of 0.25 cm from the plate was 41° lower than that of the asymptotic spectrum, and the softening effect relaxed and vanished at a distance of 5 cm. (18 figures) (auth)

6393 (AWRE-O-34/73) PENICUIK 3HS: A PROGRAM TO CALCULATE OPTIMUM ADJUSTMENTS TO NEUTRON GROUP CROSS SECTION DATA USING RESULTS OF INTEGRAL EXPERIMENTS. West, P. H. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Sep 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

The program PENICUIK calculates optimum adjustments to neutron group cross section data using as input differences between calculated and measured integral data. The current version, PENICUIK 3HS, for which there are no plans for further development, is capable of including angular spectra emerging from shells of uranium in the fitting, as well as inverse reactivities, time constants, central spectra and central reaction-rate ratios. A full description is given of the equations and their method of solution and also some special features of the program. Complete operating instructions are given. (auth)

6394 (AWRE-O-35/73) CALCULATION OF NEUTRON ANGULAR FLUX EMERGING FROM SHELLS OF NATURAL URANIUM SURROUNDING A CENTRAL SOURCE. West, P. H. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Sep 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00. UK pounds 1 net.

Energy spectra of neutrons emerging at different angles from spherical homogeneous shells of uranium surrounding a central source have been measured at Harwell; the results are intended to be used in the optimum adjustment of group cross section data. The angular flux calculated by the S_n program STRAINT is not always sufficiently accurate for it to be used in data adjustment; a second-order method is derived, and its results are discussed. Coarse representation of elastic scattering data, used in STRAINT, is shown to cause negative high-energy flux for thin regions with a central source. (7 figures, 5 tables) (auth)

6395 (EUR-5016) TIMOC 72 CODE MANUAL. Jaarsma, R.; Rief, H. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Sep 1973. 74p. Dep. NTIS (U. S. Sales Only) $5.75. EUR B. Fr. 85.-.

TIMOC 72 is a Monte Carlo Code for the solution of the energy and time dependent (or stationary) neutron transport equation in 3-dimensional geometries. It is an improved version of TIMOC (H. Kschwendt and H. Rief: TIMOC, a general purpose Monte Carlo code for stationary and time dependent neutron transport, EUR 4519.e, 1970) which is now written in FORTRAN IV IBM-system 360/370. Most of the features described in EUR. 4519.e are also incorporated in TIMOC 72. At present it uses only the very flexible 05R geometry routine, which is able to describe any body or body-combination, with surfaces of the 2nd order. A special feature allows the calculation of small perturbation effects. It is based on the method of similar flight paths and on an iteration model to approximate an adjoint weighting function as well as the possibility of splitting in the perturbed region. A "tape storage" of the characteristic parameters of neutron histories entering the perturbed region is also possible. This allows the calculation of perturbation effects for different materials without a time consuming recalculation of the whole system. In addition the TIMOC 72 code package contains the program PLOTGEOM. It generates the data for a graphical display of cross sections of the specified geometry by the CALCOMP plotter. (auth)

6396 (JINR-P4-7331) MOLECULAR FLOW OF ULTRACOLD NEUTRONS THROUGH LONG TUBES. Berchanu, I.; Ignatovich, V. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 19p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Monte Carlo calculations were performed for the transmission probability of cylindrical neutron guides and for the angular distribution of neutrons exiting the guide, the directions of motion of entering neutrons being assumed to obey the cosine law. The specular reflections are supposed to occur at the guide walls. Analytical formulae suitable for long tubes have been obtained. It is shown the directions of propagation of exiting neutrons are distributed strongly in a parallel direction to the tube axis. (auth)

6397 (LA-5428-MS) TRIPLET: A TWO-DIMENSIONAL, MULTIGROUP, TRIANGULAR MESH, PLANAR GEOMETRY, EXPLICIT TRANSPORT CODE. Reed, W. H.; Hill, T. R.; Brinkley, F. W.; Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 69p. Dep. NTIS $5.45.

TRIPLET solves the two-dimensional multigroup transport equation in planar geometries by using a regular triangular mesh. Regular and adjoint, inhomogeneous and homogeneous (k_{eff} and eigenvalue searches) problems subject to vacuum, reflective, or source boundary conditions are solved. General anisotropic scattering is allowed, and anisotropic distributed sources are permitted. The discrete ordinates approximation is used for the angular variables. A finite element method in which the angular flux is assumed to be given by a low-order polynomial in each triangle is used to solve the discrete ordinates equations. Angular fluxes are allowed to be discontinuous across triangle boundaries. A six-group, S_2, 1700-triangle, k_{eff} calculation of an EBR-II core requires about 4.4 minutes of CDC-7600 time; running times vary almost linearly with the total number of unknowns. Sources, fluxes, S_n constants, and cross sections may be read from standard interface files; flexible edit options are provided. Six scratch units and two system I/O units are required. A large bulk memory is necessary if core storage is inadequate. This program is operational on the CDC-7600, CDC-6600, and IBM-360/195 computers. (13 figures, 13 tables) (RWR)

6398 (ORNL-TM-4390) REPORT TO THE U. S. NUCLEAR DATA COMMITTEE. Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

This is a collection of recent, not generally publicized, cross-section work done at ORNL and recent papers submitted for publication. This report is prepared for the USNDC and includes only material which the author thinks might be of interest to the USNDC Subcommittee members. (auth)

For title listing of selected papers see: 6522 and 6571.

6399 (UCID-16376) LAWRENCE LIVERMORE LABORATORY EVALUATED NUCLEAR DATA LIBRARY (ENDL) TRANSLATED INTO THE ENDF/B FORMAT. Howerton, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1973. Contract W-7405-Eng-48. 47p. Dep. NTIS $4.50.

The LLL Evaluated Nuclear Data Library (ENDL) was translated into the ENDF/B Format. This translation is for the convenience of those people who wish to use the ENDL data, but whose main familiarity is with the ENDF/B formats and procedures. Only the portion of ENDL which deals with neutron-induced interactions (including photon production from neutron-induced reactions) was translated. Those parts of the ENDL library which deal with charged-particle-induced reactions were not translated, since they cannot be accommodated within the ENDF/B system. In order to provide a basis for judging the validity of the ENDL data, calculations were made of the output neutron time spectra from the LLL pulsed-sphere experiments, by using for the calculations both the ENDL cross sections and the ENDF/B-III cross sections. Comparisons between these two sets of calculations and the experimental output neutron time spectra provide a basis for judging the relative merits of the ENDL and ENDF/B-III data sets in the 5 to 20 MeV neutron-energy regime. (auth)

6400 TWO-PARTICLE CORRELATIONS IN NUCLEAR AND NEUTRON MATTER. Weyer, W. Cologne; Univ. Cologne (1972). 44p. (In German).

Thesis.

Two new methods are described for the treatment of many-nucleon systems and they applied to nuclear matter and to neutron gas. The first method uses nonspherical short-range correlations and is an extension of the method of unitary transformations. This makes it possible to take tensor forces into account also in nuclear matter. The resulting energy decrease is demonstrated for a phenomenological soft-core potential as an example. In the second part the existence of neutron pairs with equal momenta and antiparallel spins is studied in a cluster form of the neutron gas. This possibility of long-range particle correlations is an alternative to the superfluid model. The many-particle wave function is antisymmetrized by means of a systematic expansion into cluster–cluster particle-exchange contributions, in which all two-cluster effects are completely taken into account. The results of these calculations suggest a phase transition of the neutrons at higher neutron densities (about the nuclear density) which may lead to an ordering of the gas. (GE)

6401 TOTAL NEUTRON CROSS SECTIONS OF CHEMICALLY BOUND PROTONS AND DEUTERONS IN SOME METAL HYDRIDES AND DEUTERIDES. Brand, K. Kiel; Univ. Kiel (1970). 23p. (In German).

Thesis.

Using a crystal spectrometer in the FRG I, the total effective cross section per proton and deuteron of some metal hydrides and deuterides was measured. Contrary to the best known metal hydrides (ZrH_x and TiH_x), the hydrides of V, Nb and Ta showed at the time a splitting of the optical levels into two well separated excited states, which can probably be attributed to a transversal and longitudinal vibration of the proton in the crystal lattice (with VH_x only wide humps). The splitting of the vibrations is also to be seen in the effective cross section of deuteron in $NbD_{0.88}$. In $TaD_{0.63}$ there is only one level, whereas in $VD_{0.61}$ no excited state of the deuteron can be observed. The sharp equidistant minima in the curve of the effective cross section per proton in $TiH_{1.56}$ justify approximately the assumption of a simple model for this hydride, namely the harmonic isotropic oscillator model. The sharp minima in the curve of the effective cross section per proton in $YH_{1.88}$ as for titanium hydride approach a monochromatic optical frequency spectrum. (GE)

6402 EFFICIENT METHODS FOR THE TREATMENT OF RESONANCE CROSS SECTIONS. Hwang, R. N. (Argonne National Lab., IL). Nucl. Sci. Eng.; 52: No. 2, 157-175(Oct 1973).

Work was done to develop improved methods for treating resonance cross sections in both the resolved and the unresolved energy regions. The methods are natural extensions of previous methods using the J^* treatment. Efficient numerical algorithms were developed to make the methods highly economical for the routine fast reactor calculations. For the resolved energy region, a new technique is proposed for evaluating the generalized form of the resonance integral which allows the use of the multilevel formalism. By taking advantage of the asymptotic behavior of the Doppler-broadened line-shape functions, the technique of rational transformation is introduced. Gauss–Jacobi quadrature is used to evaluate the integral with the transformed integrand. The integration can be carried out efficiently. For the unresolved energy region, an accurate and efficient method was developed for estimating the effect due to in-sequence overlap. In contrast to the previously developed methods, the new method is capable of treating practically all energy regions of practical interest in fast reactor applications. The Dyson correlation function is used to account for the proper correlation of levels. The method was made economical for routine calculations. (auth)

6403 NEW VARIATIONAL METHOD FOR PULSED-NEUTRON AND DIFFUSION-LENGTH PROBLEMS IN NONMULTIPLYING ASSEMBLIES. Saini, S.; Ahmed, F.; Kothari, L. S. (Univ. of Delhi). Nucl. Sci. Eng.; 52: No. 3, 402-405(Nov 1973).

A variational method particularly suitable for the pulsed-neutron problem was suggested by Ahmed et al.; in this method, one needed the exact solution of the eigenvalue equation for two values of the buckling. In the modification suggested no solution of the eigenvalue equation is required; however, compared to the earlier method the results are a little less accurate. A similar variational method was also developed for the case of neutron diffusion. As examples, the decay of a neutron pulse and neutron diffusion in beryllium and beryllium oxide blocks were studied. (auth)

6404 CALCULATION OF NEUTRON AGE FROM EXPERIMENTS USING EXTENDED PLANAR SOURCES. Gore, B. F. (Northwest Coll. and University Assoc. for Science, Richland, WA). Nucl. Sci. Eng.; 52: No. 2, 209-214(Oct 1973).

In a class of experiments using extended planar sources, the age of fission neutrons is calculated by "correcting" the measured second moment of the flux through the use of a series in the higher flux moments. In this paper, the "correction" is generalized to include terms in addition to the leading term of an eigenfunction expansion of the neutron source distribution. In the generalized correction series, expansion coefficients are shown to be series themselves, which cannot be shown to converge in general. Examination of physically reasonable examples, one of which included only the effect of the energy-dependent extrapolation length of a published experiment, reveals divergences in the series for all expansion coefficients but that of the leading term in the correction series. Since the assumption of an energy-independent extrapolation length was central to the derivation of the correction series in question, this indictment is quite general. (2 tables)(auth)

6405 THEORY OF INELASTIC NEUTRON SCATTERING FROM SUPERFLUID He^4 WITH A FREE SURFACE. Saam, W.F. (Department of Physics, Ohio State University, Columbus, Ohio 43210). Phys. Rev. A 8: No. 2, 1048-1053 (Aug 1973).

It is shown that one can take advantage of total neutron reflection at a free surface to eliminate volume-proportional terms in inelastic neutron scattering. When this is done, the neutron inelastic-scattering cross section for superfluid He^4 with a free surface is found, within an ideal-fluid model, to contain only ripplon peaks distinctly separated from a smooth background due to nonresonant single-phonon processes occurring near the surface of the liquid. Some numerical results are given for the predicted cross section. (auth)

6406 NEUTRON SLOWING AND THERMALIZATION IN ATOMIC HYDROGEN GAS. Murray, R. L. (North Carolina State Univ., Raleigh); Kuehn, N. H.; Wu, S.; Bullard, A. G. J. Nucl. Energy; 27: No. 10, 691-723(Oct 1973).

The neutron spectrum resulting from a monoenergetic source in an infinite medium, composed of atomic hydrogen gas and a 1/v absorber, is evaluated by series methods applied to integral and differential equations. The properties of the series that make up a fundamental set of solutions are examined. The classic analysis of Wigner and Wilkins is extended by determining the Green's function for thermalization, a new interpretation is provided for the relationship of asymptotic and small argument series, and calculations are reported for a variety of physical situations. (auth)

6407 AMBIGUITY IN THE DEFINITION OF EFFECTIVE DIFFUSION COEFFICIENTS IN SLAB LATTICES. Gelbard, E. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 233-234(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6408 EVALUATION TOOLS FOR USE WITH CSISRS AND ENDF DATA. Kinsey, R. R. (Brookhaven National Lab., Upton, NY); Garber, D. I.; Rindfleisch, C.; Ozer, O. Trans. Amer. Nucl. Soc.; 17: 234(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6409 QUADRATIC FINITE ELEMENTS IN NEUTRON TRANSPORT. Miller, W. F. Jr.; Lewis, E. E. (Northwestern Univ., Evanston, IL). Trans. Amer. Nucl. Soc.; 17: 235(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6410 VACUUM DESCRIPTION IN SYMMETRIZED TRANSPORT CALCULATIONS. Pitkaeranta, J. (Helsinki Univ. of Tech., Otaniemi, Finland); Silvennoinen, P. Trans. Amer. Nucl. Soc.; 17: 235-236(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6411 SINGULAR ELEMENTS IN VARIATIONAL AND FINITE ELEMENT TRANSPORT COMPUTATIONS. Abu-Shumays, I. K.; Bareis, E. H. (Northwestern Univ., Evanston, IL). Trans. Amer. Nucl. Soc.; 17: 236-237(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6412 FINITE ELEMENT INTEGRAL NEUTRON TRANSPORT. Lewis, E. E.; Miller, W. F. Jr. (Northwestern Univ., Evanston, IL). Trans. Amer. Nucl. Soc.; 17: 237-238(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6413 FINITE ELEMENT SOLUTIONS FOR MULTIREGION PROBLEMS. Jacquin, J. C.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 17: 238-239 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6414 SINGULARITIES IN THE FINITE ELEMENT APPROXIMATION OF TWO-DIMENSIONAL DIFFUSION PROBLEMS. Hennart, J. P. (Centro de Investigaciones y Estudios Avanzados, Mexico City); Mund, E. H. Trans. Amer. Nucl. Soc.; 17: 239-240(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6415 HIGHER ORDER VARIATIONAL PRINCIPLES AND PADE APPROXIMANTS FOR LINEAR FUNCTIONALS. Conn, R. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 240-241(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition, San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6416 STOCHASTIC OPTIMAL ESTIMATION APPROACH TO MONTE CARLO EIGENFUNCTION CONVERGENCE. Swaja, R. E. (Westinghouse Electric Corp., West Mifflin, PA); Poncelet, C. G. Trans. Amer. Nucl. Soc.; 17: 259(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6417 ANALYTICAL SLOWING DOWN BENCHMARK SOLUTION. Ganapol, B. (CEA, Saclay, France); Benoist, P.; Henninger, R.; Peddicord, K. L. Trans. Amer. Nucl. Soc.; 17: 334-335(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6418 DEVELOPMENT OF THE ENDF/B-IV LIBRARY. Ozer, O. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 483(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6419 MULTIGROUP CROSS-SECTION DEPENDENCE ON WEIGHTING FUNCTION MODEL. Weisbin, C. R. (Los Alamos Scientific Lab., NM); Hendricks, J. S.; Cullen, D. E.; Oblow, E. M.; Soran, P. D. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 483-484(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6420 MULTIPLICATION FACTOR DEPENDENCE ON NUMBER OF MULTIGROUPS AND WEIGHTING FUNCTION MODEL. Soran, P. D. (Los Alamos Scientific Lab., NM); LaBauve, R. J.; Weisbin, C. R.; Hendricks, J. S. Trans. Amer. Nucl. Soc.; 17: 484-485(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6421 TRANSPORT CORRECTION FROM INTEGRAL TRANSPORT THEORY. Jonsson, A. (Vallenbyggnadsbyran AB, Stockholm); Goldstein, R. Trans. Amer. Nucl. Soc.; 17: 485-486(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6422 DETERMINATION OF MULTIGROUP WEIGHTING SPECTRA AND CROSS SECTIONS. Cullen, D. E. (Univ. of California, Livermore); Weisbin, C. R. Trans. Amer. Nucl. Soc.; 17: 488-489(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6423 EFFICIENT REPRESENTATION OF NUCLEAR CROSS SECTIONS ON A COMMON ENERGY MESH. Klein, M. (Los Alamos Scientific Lab., NM); Weisbin, C. R.; LaBauve, R. J.; Ozer, O. Trans. Amer. Nucl. Soc.; 17: 489-490(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6424 ANALYSIS OF ^{239}Pu AND ^{235}U RESONANCE SELF SHIELDING EXPERIMENTS. Koenig, D. R.; Carter, L. L. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 491-492(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6425 EVALUATED DECAY SCHEME DATA. Helmer, R. G.; Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 517(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6426 SELECTION OF GROUP ENERGY BOUNDARIES USING SENSITIVITY THEORY. Oblow, E.; Ching, J.; Drischler, J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 547-548(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6427 ENERGY SPECTRUM MEASUREMENTS OF SCATTERED NEUTRONS FROM NITROGEN. Harris, L. Jr.; Young, J. C. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 550-551(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6428 MONTE CARLO CALCULATIONS OF EXPERIMENTS WITH NITROGEN AND CARBON. Cohen, M. O.; Beer, M. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 551-552(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 5690, 6147, 6274–6276, 6622, and 6773.

6429 (COO-3058-42) TOTAL CROSS SECTION OF NEUTRONS ON DEUTERIUM IN THE keV REGION. Stoler, P.; Kaushal, N. N.; Green, F. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1973. 8p. Dep. NTIS $3.00.

Total neutron cross sections on deuterium in the energy range 1 keV to 1000 keV were measured, and basically agree with our previously reported results. (auth)

6430 (HMI-B-137, p 18) REACTION ^{3}H(τ,n)^{5}Li. Masterson, T. G. (In German).

6431 (ISS-72/14) ELECTRON SCATTERING AND FEW NUCLEON SYSTEMS. Amaldi, U. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 14 Sep 1972. 38p. (CONF-720819-20). Dep. NTIS (U. S. Sales Only) $4.00.

From international conference on few particle problems in nuclear interactions; Los Angeles, California, USA (28 Aug 1972).

Deuterium, three nucleon systems, and ^{4}He are considered, presenting the experimental information on the charge and magnetic form factors and an electrodisintegration processes. The out put of these calculations about the high momentum behavior of the form factor is reviewed. (auth)

6432 (LYCEN-7338) p-^{4}He COHERENT SCATTERING AT 24 GeV/c. Observation of Elastic Scattering and Production Processes by a Missing Mass Method. Berthot, J.; Gardes, J.; Meritet, L. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1973. 6p. (CONF-730642-10). Dep. NTIS (U. S. Sales Only) $3.00.

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The coherent scattering of protons on helium-4 was observed at 24 GeV/c using a missing mass method, i.e. detecting the recoil nucleus and measuring with a high accuracy its identification

parameters, angle and energy. The angular spectrum of ^{4}He for each energy channel in single and double scattering t region exhibits some peaks due to baryon resonances (N^* 1/2) at a rest mass of 1500 and 1700 MeV. (auth)

6433 (ORO-3491-21, pp 4-15) ELASTIC PROTON SCATTERING FROM ^{3}He AND ^{4}He AND THE ^{4}He(p,d)^{3}He REACTION AT 85 MeV. Votta, L. G.; Roos, P. G.; Chant, N. S.; Woody, R. III. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6434 (ORO-3491-21, pp 52-65) D(p,2p)n AND D(p,pn)p REACTIONS AT 65, 85, AND 100 MeV. Cheng, V. K. C.; Roos, P. G. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6435 (ORO-3491-21, pp 66-69) COMPARISON OF THE ^{3}He(p,2p)d AND ^{3}He(p,pd)p REACTIONS. Cowley, A. A.; Roos, P. G.; Pugh, H. G.; Cheng, V. K. C.; Woody, R. III. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6436 (ORO-3491-21, pp 70-73) ^{3}He(p,2p)pn REACTION. Roos, P. G.; Cowley, A. A.; Pugh, H. G.; Cheng, V. K. C.; Woody, R. III. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6437 MEASUREMENT OF THE NEUTRON POLARIZATION FROM D(p,n)2p. Rad, F.N.; Northcliffe, L.C.; Rogers, J.G.; Saylor, D.P. (Cyclotron Institute, Texas A & M University, College Station, Texas 77843). Phys. Rev. Lett. 31: No. 1, 57-60 (2 July 1973).

The polarization of breakup neutrons from the reaction D(p,n)2p has been measured at E_p=21.5 MeV as a function of neutron energy with accuracy of approximately $\pm$0.01. The high-energy neutrons ($E_n > 14$ MeV) show a small but significant positive polarization ($P_n \approx 0.015$), in disagreement with the prediction ($P_n = 0$) of the Amado model and also in disagreement with expectations if the dominant process were simple quasifree p–n scattering. (auth)

6438 NEUTRON CONTINUUM FROM THE ^{9}Be + α REACTION. Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.); van der Zwan, L.; Geiger, K. W. Z. Phys.; 259: No. 3, 275-284 (1973).

Spectra of the low energy neutron continuum between 0.1 and 2.4 MeV from the Be + α reaction were measured at 5.01, 5.44, 6.37 and 7.44 MeV bombarding energies and different angles of neutron emission. The intensity is strongly peaked in the forward direction and the neutron distributions show maxima between 0.3 and 0.6 MeV. The results are consistent with the assumption that the continuum is due to the sequential decay ^{9}Be(α,α')^{9}Be* $\rightarrow$ ^{8}Be + n. .The shape and magnitude of the continuum from a ^{241}A m-Be(α,n) source were determined as well. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 5690, 6469, 6486, 6487, 6518, 6599, 6605, and 6622.

6439 (FRNC-R-24) ELASTIC SCATTERING OF TRITONS BY ^{16}O. Wery, M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. des Basses Energies). 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The angular distributions and excitation functions were measured for the ^{16}O(t,t) reaction from 1.4 to 3.7 MeV triton energy using a differentially pumped gaseous target. The observed resonances were analyzed with the Humblet-Rosenfeld theory. It appears that the excitation range of the compound system of ^{19}F (13-15 MeV) is dominated by several levels of large triton partial width. The levels populated in the three-particle transfer reaction (^{7}Li,α) on ^{16}O are compared with the resonances. (FR)

6440 (HMI-B-137, p 19) REACTION ^{9}Be(τ,n)^{11}C. Masterson, T. G. (In German).

6441 (HMI-B-137, pp 20-21) REACTION ^{10}B(τ,n)^{12}N. Masterson, T. G. (In German).

6442 (HMI-B-137, pp 21-22) REACTION ^{12}C(τ,n)^{14}O AT 13 MeV. Hilser, D. (In German).

6443 (HMI-B-137, pp 22-24) REACTION ^{13}C(τ,n)^{15}O AT 10 MeV. Bohne, W. (In German).

6444 (HMI-B-137, p 25) REACTION ^{14}C(τ,n)^{16}O. Bohne, W.; Jahnke, U. (In German).

6445 (HMI-B-137, pp 26-28) REACTION ^{14}N(τ,n)^{16}F. Hilscher, D. (In German).

6446 (HMI-B-137, p 32) SPECTROSCOPY OF ^{15}N BY MEANS OF THE ^{14}C(d,n) REACTION. Ekpo, M. (In German).

6447 (HMI-B-137, pp 33-34) PROTON STRIPPING TO UNBOUND STATES: THE (d,n) REACTION ON ^{12,13,14}C. Ekpo, M.; Fuchs, H.; Grabisch, K. (In German).

6448 (LA-tr-73-46(Dr.)) 3RD PART. Research With the 600-MeV Linear Accelerator. II. Experimental Works. III. Experimental Techniques. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. Translated from CEA-N-1600. 36p. Dep. NTIS $4.00.

An abstract of this report, prepared from the original language, appeared in NSA as 28: 22775; abstracts of individual papers appearing in the report are also presented with 28: 22775. (RWR)

6449 (LA-UR-73-1578) REVIEW OF EVALUATED CROSS SECTION DATA FOR AIR AND GROUND CONSTITUENTS. Young, P. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 14p. (CONF-730935-2). Dep. NTIS $3.00.

From EMP technical meeting; Kirtland AFB, New Mexico, USA (25 Sep 1973).

During the past few years the Defense Nuclear Agency has sponsored a radiation transport program that has the goal of substantially reducing uncertainties in predictions of radiation environments. Important aspects of the program have been to provide new cross section measurements directed particularly at areas of ignorance in the data for several important materials and to maintain up-to-date cross section evaluations that fully incorporate the new experimental information. As a result, significant improvements have been made in recent years in the availability and accuracy of evaluated data for a number of materials, particularly in the area of gamma ray production. In the present paper a review is given of the status of evaluated cross section data for common air and ground constituents including C, N, O, Al, Si, Ca, and Fe. Particular emphasis is given to the air materials and to recent improvements in gamma ray production data. Comparisons of presently available evaluated data with the results of extensive new experimental measurements are given, and summaries of estimated errors in the evaluated data are presented. The increased accuracy of cross sections for other processes, such as neutron inelastic scattering and charged-particle production, that results from the improved gamma ray data is discussed. In addition, likely future trends in the evaluated data sets for air and ground constituents are outlined. (auth)

6450 (NP-19852, pp 37-42) DWBA AND COUPLED CHANNEL ANALYSES OF INELASTIC SCATTERING OF ^{3}He FROM ^{12}C. Fujisawa, T.; Yamaji, S.; Matsuda, K.; Motonaga, S.; Yoshida, F.; Sakaguchi, H.; Masui, K. Dec 1972.

6451 (NP-19852, pp 58-65) COUPLING BETWEEN VALENCE NUCLEON AND CLUSTERIZED CORE. Takigawa, N. Dec 1972.

6452 (ORO-3491-21, pp 74-80) (p,2p) REACTION ON ^{6}Li. Bhowmik, R.; Chang, C. C.; Roos, P. G.; Holmgren, H. D.; Marion, J. B. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6453 (ORO-3491-21, pp 81-88) ^{6}Li(p,pd)α REACTION AT 100 MeV. Chang, C. C.; Bhowmik, R.; Holmgren, H. D.; Marion, J. B.; Roos, P. G. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6454 (ORO-3491-21, pp 89-96) ^{6}Li(p,pα)^{2}H AND ^{6}Li(p,ph)^{3}H REACTIONS AT 100 MeV. Goldberg, D. A.; Roos, P. G.; Woody, R. III; Reichart, W. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6455 (ORO-3491-21, pp 97-111) QUASI-FREE REACTIONS. Bhowmik, R.; Burdzik, G. F.; Chang, C. C. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6456 (ORO-3491-21, pp 123-131) ANALYSIS OF THE ^{6}Li (p,2p)^{5}He(g.s.) REACTION AT E_p = 100 MeV. Chang, C. C.; Roos, P. G.; Bhowmik, R.; Chant, N. S. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6457 INVESTIGATION OF (α,t) AND (α,^{3}He) REACTIONS AT 104 MeV. Hauser, G. Heidelberg; Univ. Heidelberg (1971). 49p. (In German).

Thesis.

The angle distribution of the reactions $^{12}C(\alpha,t)^{13}N$, $^{12}C(\alpha,^3He)^{13}C$, $^{27}Al(\alpha,t)^{28}Si$, $^{40}Ca(\alpha,t)^{41}Sc$ and $^{40}Ca(\alpha,^3He)^{41}Ca$ were measured on the isochronous cyclotron, Karlsruhe, with an injection energy of 104 MeV. All angle distributions are mainly characterized by an exponential fall and show little structure. The experimental data were analyzed using the DWBA theory in order to obtain the spectroscopical factors. The thus necessary optical parameters for the inlet channel are obtained from the analysis of the elastic scattering of 104 MeV α-particles, whereas the relevant data for the outlet channel are taken from the literature. The influence of nonlocality effects and finite range corrections as well as of a lower cut off were examined. The normalization factor for both reaction types A(α,t)B and A(α,^{3}He)B can be determined from the data for the reactions on the ^{40}Ca target nucleus. (GE)

6458 REARRANGEMENT IN THE BRUECKNER–HARTREE–FOCK APPROACH. Muether, H.; Faessler, A.; Goeke, K. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A215: No. 1, 213-220(1973).

The rearrangement effects in ^{16}O due to the knock-out of a proton are studied in the framework of Brueckner–Hartree–Fock theory. In the calculations both the Pauli operator and the starting energies are treated self-consistently. The partition of the total rearrangement into orbital rearrangement and Brueckner rearrangement originating from the changes of the starting energies and the Pauli operator is investigated, and their coupling is studied. The total rearrangement energy turns out to be of the order of 15 and 10 MeV for the 0s and 0p states, respectively, and seems to be governed mainly by the Brueckner rearrangement coming from the starting energy. (auth)

6459 FOUR-NUCLEON TRANSFER REACTIONS AMONG HEAVY IONS. Arima, A.; Broglia, R. A.; Ichimura, M.; Schaefer, K. (State Univ. of New York, Stony Brook). Nucl. Phys.; A215: No. 1, 109-131(1973).

The reaction $^{16}O(^{16}O,^{12}C)^{20}Ne$ is studied by making use of the Buttle–Goldfarb approximation. For the potential entering the DWBA integral, an effective potential V^{eff} between the transferred α particle and the core nucleus is chosen. The influence of different choices for V^{eff} is discussed, and the results for the post and prior forms are compared. (auth)

6460 PHOTONEUTRON CROSS SECTIONS OF ^{10}B AND ^{11}B. Hughes, R. J.; Muirhead, E. G. (Univ. of Melbourne). Nucl. Phys.; A215: No. 1, 147-156(1973).

The absolute total photoneutron cross sections of ^{10}B and ^{11}B were deduced from bremsstrahlung yield curves for the reactions measured from threshold to 28 MeV. Neutron yields were measured using direct neutron counting, and were analyzed using the variable-bin Penfold–Leiss method. The integrated cross sections from thresholds to 27.6 MeV were found to be 0.36 ± 0.04 for ^{10}B and 0.37 ± 0.04 for ^{11}B, both given in units of 60 NZ/A. It is found that shell-model calculations which have been carried out for these nuclei are inadequate in their description of the detail seen experimentally, particularly in the case of ^{10}B. A discussion of the possibility of isospin splitting in ^{11}B is also given. (auth)

6461 MEASUREMENT AND MICROSCOPIC ANALYSIS OF THE REACTIONS ^{6}Li(^{6}Li, ^{6}Li* (3.56))^{6}Li* (3.56) AND ^{6}Li(^{6}Li, ^{6}He)^{6}Be. Wharton, W.R.; Cramer, J.G.; Wilkinson, D.H.; Calarco, J.R.; Nair, K.G. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 31: No. 1, 54-57 (2 July 1973).

Angular distributions and an excitation function have been measured for the reactions ^{6}Li(^{6}Li, ^{6}Li* (3.56))^{6}Li* (3.56) and ^{6}Li(^{6}Li, ^{6}He)^{6}Be at laboratory bombarding energies between 28 and 36 MeV. A microscopic distorted-wave Born-approximation analysis which includes the tensor interaction and exchange gives good agreement with the data, except at forward angles, and predicts the correct magnitude of the cross sections. Estimates of the strengths of the effective Majorana and spin-tensor isospin interactions are given. (auth)

6462 POSSIBLE OBSERVATION OF THE TRIANGLE GRAPH THROUGH INTERFERENCE WITH POLE GRAPHS. Duck, I. M. (Rice Univ., Houston, TX); Valkovic, V. Lett. Nuovo Cim.; 8: No. 9, 537-543(27 Oct 1973).

The interference of rescattering graphs with pole graphs as it modulates the excitation function of a resonance is considered. Estimates of the size of the rescattering singularities are presented. Several reactions are considered as possible candidates for the observation of the triangle-graph contribution in the measurement of the excitation function. (auth)

6463 HIGH PRECISION MEASUREMENTS OF THE NUCLEAR MAGNETIC DIPOLE MOMENTS OF ^{6}Li, ^{7}Li, ^{39}K, AND ^{41}K. Beckmann, A.; Boeklen, K. D.; Elke, D. (Univ., Bonn). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft on atomic and molecular physics; Munich, Germany (2 Apr 1973).

The field-independent transitions $\Delta m(J) = 0$, $\Delta m(I) = 1$ in the $^2S_{\frac{1}{2}}$ ground state were measured for the alkali isotopes ^{6}Li, ^{7}Li, ^{39}K, ^{41}K of magnetic fields from 2.5 to 3 KOe by means of the triple resonance method and the technique of separated rf fields. From these measurements, the ratio g(I)/g(J) was determined with a relative accuracy better than 10^{-6}. Using g(J) factors that were calibrated by the g(J) value of the free electron, the g(I) factors can be determined with an absolute accuracy of 10^{-6}. From comparison with NMR measurements the diamagnetic shielding of positive alkali ions by H_2O molecules is obtained. (GE)

6464 STRUCTURE OF STATES IN ^{20}Ne FROM THE REACTIONS $^{18}O(^{11}B,^9Li)^{20}Ne$ AND $^{16}O(^{11}B,^7Li)^{20}Ne$. Strottman, D.; Anyas-Weiss, N.; Cornell, J. C.; Fisher, P. S.; Hudson, P. N.; Menchaca-Rocha, A.; Panagiotou, A. D.; Scott, D. K. (Nuclear Physics Lab., Oxford). Phys. Lett., 47B: No. 1, 16-18(15 Oct 1973).

The failure to observe the 4^+ and 6^+ states at 10.8 and 12.56 MeV in ^{20}Ne in the $^{18}O(^{11}B,^9Li)^{20}Ne$ reaction indicates that these states are $(pf)^4$ rather than $(sd)^2$. States seen in the $^{16}O(^{11}B,^7Li)^{20}Ne$ reaction are also interpreted. (auth)

6465 CROSS SECTION FOR THE DELAYED-NEUTRON YIELD FROM THE ^{9}Be(n,p)^{9}Li REACTION AT NEUTRON ENERGIES BETWEEN 14.1 AND 14.9 MeV. Augustson, R. H.; Menlove, H. O. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 494(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6466 MEASUREMENT OF ^{10}B(n,t) CROSS SECTION IN A FAST-NEUTRON SPECTRUM. Lippincott, E. P.; Pitner, A. L.; Kellogg, L. S. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 494-495(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6467 INTEGRATED (n,α) CROSS SECTION OF BORON BY HELIUM MEASUREMENT. Farrar, H. IV (Atomics International, Canoga Park, CA); McElroy, W. N. Trans. Amer. Nucl. Soc.; 17: 520(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 6449, 6457, 6481, 6500, 6506, 6518, 6599, 6604, 6615, and 6622.

6468 (HMI-B-137, p 38) TOTAL EXCITATION CROSS SECTION OF ^{24}Mg FOR NEUTRONS. Bommer, J. (In German).

6469 (HMI-B-137, pp 39-40) COMPARISON OF THE NEUTRON STRENGTHS IN THE NEUTRON TOTAL CROSS SECTION AND IN THE (d,p) REACTION. Bommer, J.; Fuchs, H.; Grabisch, K.; Lipperheide, R.; Moehring, K. (In German).

6470 (NP-19852, pp 43-44) $^{20}Ne(d,^6Li)^{16}O$ REACTION. Odera, M.; Takeda, S.; Nakajima, S. Dec 1972.

6471 VARIATIONAL DETERMINATION OF FEW-NUCLEON SUBSTRUCTURES IN NUCLEI. Catara, F.; Gomez, J. M. G. (CEN de Saclay, Gif-sur-Yvette Saclay, France). Nucl. Phys.; A215: No. 1, 85-90(1973).

A method for a variational and self-consistent determination of the sub-structures in nuclei described as two interacting subsystems outside a core is presented. Results for pairs and quartets in ^{20}Ne and ^{24}Mg are given. (auth)

6472 On-LINE MASS-SPECTROMETRIC MEASUREMENT OF THE MASSES OF NEUTRON-RICH SODIUM ISOTOPES. Klapisch, R.; Prieels, R.; Thibault, C.; Poskanzer, A.M.; Rigaud, C.; Roeckl, E. (Laboratoire René Bernas du Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, 91406 Orsay, France). Phys. Rev. Lett. 31: No. 2, 118-121 (9 July 1973).

Using an on-line mass spectrometer, we have measured directly, to an accuracy of 150 to 500 keV, the masses of $^{27-36}$Na produced in the reaction of 24-GeV protons on uranium. (auth)

6473 NMR INVESTIGATIONS AND NUCLEAR MAGNETIC MOMENT OF ^{33}S. Lutz, O.; Nolle, A.; Schwenk, A. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 28a: No. 8, 1370-1372(1973).

The ratio of the Larmor frequencies of ^{33}S and ^{85}Rb has been measured, and a magnetic moment for ^{33}S of $\mu(^{33}S)$ in SO_4^{2-} in D_2O) = 0.6431028(14) μ_N has been calculated. ^{33}S chemical shifts have been determined, and the SO_4^{2-} ion in aqueous alkali sulfate solutions is proposed as ^{33}S NMR reference compound. (1 figure, 1 table) (auth)

6474 INVESTIGATION OF THE SHELL STRUCTURE OF NUCLEI IN THE 2s-1d SHELL WITH TRANSFER REACTIONS. Mackh, H. Heidelberg; Univ. Heidelberg (1971). 42p. (In German).

Thesis.

The angle distributions of the (d,^{3}He) reaction on the target nuclei ^{28,30}Si, ^{29}Si, ^{31}P, ^{32}S and ^{36}Ar at a deuteron energy of 52 MeV were measured. The absolute effective cross sections were obtained. By comparing the experimental angle distributions with DWBA calculations, the quantum numbers of states in the product nuclei ^{27,29}Al, ^{28}Al, ^{30}Si, ^{31}P and ^{35}Cl and spectroscopic factors were determined. The effective particle-hole interaction parameters can be found from the systematic position of 1p-proton or neutron hole states in nuclei of the 2s-1d shell. These parameters are in good agreement with the values given by Zamick. (GE)

6475 ALPHA-WIDTHS OF ^{20}Ne BASED ON ^{16}O AND ALPHA-CLUSTER MODEL. Matsuse, T.; Kamimura, M. (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1765-1767 (May 1973).

A quantitative evaluation of alpha widths and spectroscopic factors of the ground-state band and first K = 0$^-$ band of ^{20}Ne based on the orthogonality condition model approximated from the resonating group method is given. (JFP)

6476 ELECTROFISSION OF MAGNESIUM. Litherland, A. E. (Univ. of Toronto). Rev. Brasil. Fis.; 2: No. 1, 101-118(Mar 1972).

A method to study electrofission of magnesium and other light elements is presented. Accelerators and etch pit technique are used. The technique is specifically described, and a Polycarbonate Damage Track (PDT) detector is used. Special attention is given to symmetrical fission of ^{24}Mg. ^{24}Mg might be expected to show a larger cross section for electrofission than ^{27}Al. (auth)

6477 CROSS-SECTIONS OF 14 MeV NEUTRON REACTIONS PRODUCING SHORT-LIVED NUCLIDES. Janczyszyn, J.; Gorski, L. (Inst. of Nuclear Techniques., Krakow). J. Radioanal. Chem.; 14: No. 1, 201-206(Mar 1973).

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 5689, 6457, 6463, 6477, 6506, 6518, 6521, 6525, 6605, 6606, 6615, and 6622.

6478 (HMI-B-137, pp 28-31) INVESTIGATION OF STATES IN fp-SHELL NUCLEI WITH THE (τ,n) REACTION. Kluge, H. (In German).

6479 (INIS-mf-331) CONTRIBUTION TO THE STUDY OF NEUTRON CAPTURE IN Al, Ni, Ti, AND Fe. de Abreu, M. A. N. (Universidade Estadual de Campinas (Brazil)). 1970. 128p. (In Portuguese). INIS.

Thesis.

The nuclear structure of Al, Fe, Ni and Ti was studied by radioactive neutron capture. A neutron flux over 10^{11}n/cm^{2}s from the IEAR-1 reactor at 2 MW was used as a source. The issuing gamma radiation was detected by a home-made 15 cm^3 volume Ge(Li) detector and a 1024 channel analyser. (INIS)

6480 (ISS-72/18) PROBLEM IN QUASI-FREE SCATTERING AT HIGH MISSING ENERGY ^{40}Ca AS AN EXAMPLE. Frullani, S. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 29 Dec 1972. 30p. (CONF-720933-6). Dep. NTIS (U. S. Sales Only) $3.50.

From symposium on present status and novel developments in the nuclear many-body problem; Rome, Italy (19 Sep 1972).

Experimental data on the knocking-out of deep-bound protons in ^{40}Ca in quasi-free scattering experiments and some open problems in the interpretation of this type of reactions are reviewed. (auth)

6481 (KFK-1668) STATUS OF NEUTRON NUCLEAR DATA FOR IMPORTANT FAST REACTOR STRUCTURAL AND COOLANT MATERIALS. Schatz, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1972. 105p. Dep. NTIS (U. S. Sales Only) $7.25.

The present status of knowledge of the neutron nuclear data for the most important structural materials (nickel, iron, chromium) and the predominant coolant material (sodium) is presented. For this purpose the available experimental information on these data is reviewed. In particular, the improvements in the data situation attained in recent years are examined. Elastic scattering angular distributions are not considered. Essentially only the literature references compiled in CINDA 71 including its Supplement 2 were taken into account. (4 tables, 123 references) (auth)

6482 (NP-19852, pp 23-26) STUDY OF TRANSFER REACTIONS INDUCED BY 90 MeV ^{14}N ON ^{52}Cr. Kohno, I.; Nakajima, S.; Yamane, I.; Yoshie, M.; Odera, M.; Kamitsubo, H. Dec 1972.

6483 (NP-19852, pp 27-29) SELECTIVE EXCITATION OF ONE PROTON CONFIGURATION FOR ^{53}Mn IN ^{52}Cr(^{14}N, ^{13}C)^{53}Mn AND ^{52}Cr(^{12}C,^{11}B)^{53}Mn. Nakajima, S.; Kohno, I.; Yamane, I.; Yoshie, M.; Kamitsubo, H.; Odera, M.; Mikumo, T. Dec 1972.

6484 (ORNL-4810) NATURAL TITANIUM NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 4.07 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 35p. Dep. NTIS $4.00.

Measured cross sections per atom of natural titanium for neutron elastic scattering and for inelastic scattering to levels in ^{48}Ti for incident neutron energies between 4.07 and 8.56 MeV are given and compared with previous results. ENDF/B III MAT 1144 angular distributions are in reasonably good agreement with experimental results at angles less than 40 degrees but differ by as much as an order of magnitude at larger angles. The ENDF/B III MAT 1144 angle-integrated elastic scattering cross sections agree within experimental uncertainties with experimental results at energies below 6.44 MeV but rise 20% above measured values at 8.56 MeV. ENDF/B III MAT 1144 inelastic scattering cross sections to discrete levels in ^{48}Ti are in poor agreement with experimental data because of the predominance of continuum inelastic scattering in ENDF/B III MAT 1144. An evaporation model of inelastic scattering to the continuum is found to be valid for inelastic scattering to levels of excitation energy greater than 6 MeV but is questionable for inelastic scattering to levels of lower excitation energy. (auth)

6485 (ORNL-TM-4379) GAMMA-RAY PRODUCTION FROM NEUTRON INTERACTIONS WITH NICKEL FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 10 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 57p. Dep. NTIS $5.45.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with nickel were obtained for neutron energies between 1.0 and 20 MeV. These data were obtained using two different experimental systems: (a) $d^2\sigma/d\omega dE$ values were obtained for θ_γ = 125 deg using a NaI spectrometer. These data are presented as gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \sim 9$ MeV. Neutron energy intervals varied from 0.5 MeV for En = 1 to 8 MeV to 3 MeV for En = 14 to 20 MeV. (b) Discrete line values of $d\sigma/d\omega$ for transitions due to neutron interactions with nickel were obtained at θ_γ = 55 or 125 deg for En = 4.85, 5.4, and 5.9 MeV using Ge(Li) spectrometers. (auth)

6486 (ORO-3491-21, pp 22-30) SCATTERING OF 101-MeV HELIONS FROM ^{12}C, ^{40}Ca, AND ^{58}Ni. Goldberg, D. A.; Smith, S. M. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6487 (ORO-3491-21, pp 31-36) NUCLEAR REFRACTION EFFECTS IN SCATTERING OF 101-MeV HELIONS. Smith, S. M.; Goldberg, D. A. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6488 NEGATIVE PARITY STATES OF ^{109}Ag IN THE INTERMEDIATE-COUPLING UNIFIED NUCLEAR MODEL. Nagib, I. M.; Thomas, D. J.; Wakefield, B. (Univ. of Liverpool). J. Phys., A (London); 6: No. 10, 1580-1593(Oct 1973).

Application of the particle-harmonic vibrator intermediate-coupling model to the negative parity states of ^{109}Ag yields good agreement with the experimental level spectrum but has limited

success in reproducing E2 and M1 properties. Better overall agreement with experiment is obtained on applying the quasi-particle-anharmonic vibrator version of the model. (auth)

6489 HOLE STATES IN NUCLEI OF THE (fp) SHELL. Wennels, S. Heidelberg; Univ. Heidelberg (1971). 56p. (In German).

Thesis.

In order to determine the proton hole states in vanadium isotopes, the (d,^{3}He) reactions on the ^{50}Cr, ^{52}Cr and ^{53}Cr nuclei were investigated with an injection energy of 52 MeV. For a larger number of nuclei of the $1f_{7/2}^{-1}$ and $2p_{3/2}^{-1}$ shell, the experimental center of mass energies of the $1d_{3/2}^{-1}$ and $2s_{1/2}^{-1}$ hole states were combined. These centers of mass energies were calculated with a three parameter formula for the effective particle-hole interaction. (GE)

6490 ELASTIC SCATTERING OF α-PARTICLES BY ^{54}Fe FROM 8 TO 15 MeV. Yaramis, B.; Tolbert, D. D.; Davis, R. H. (Florida State Univ., Tallahassee). Nucl. Phys.; A215: No. 1, 197-204(1973).

Twenty-eight-point angular distributions for the elastic scattering of α particles by ^{54}Fe were measured using bombarding energies of 8 to 15 MeV over an angular range of 25 to 175° (lab). The data were analyzed using a five-parameter (the real and imaginary well depths, their respective radii, and a common diffuseness parameter) optical model. Two discretely ambiguous real depths were found at 15 MeV; but only one, at about 42.5 MeV, was satisfactory throughout the energy range. Overall fits to the data are comparable to those found previously for scattering by ^{40}Ca and several heavier nuclei ($A \approx 100$). This case appears to be intermediate between the relatively low absorption parametrization for scattering by ^{40}Ca and the large absorption which characterized the heavy target data. (auth)

6491 ROLE OF THE IMAGINARY FORM FACTOR IN THE MICROSCOPIC DESCRIPTION OF (p,p') SCATTERING FROM NUCLEI WITH ONE CLOSED SHELL. Terrien, Y. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A215: No. 1, 29-44(1973).

The inelastic scattering of protons from the lowest 2^+ and 3^- levels in ^{40}Ca, Ni, Sn, and N = 50 isotopes is analyzed for different incident proton energies. The addition of a collective imaginary term to the microscopic real form factor very much improves the agreement between the calculated and experimental cross section angular distributions. The variation with energy of the relative contributions of the $\Delta T = 1$ and $\Delta T = 0$ isospin parts of the transitions is discussed. (auth)

6492 SPINS AND LIFETIMES OF LEVELS IN ^{55}Mn. Hichwa, B. P.; Lawson, J. C.; Chagnon, P. R. (Univ. of Notre Dame, IN). Nucl. Phys.; A215: No. 1, 132-146(1973).

The study of excited ^{55}Mn levels with the ^{52}Cr(α,pγ) reaction was extended to levels up to 3161 keV. With a Ge(Li) detector, DSA measurements in gold-backed targets were made, as well as angular correlations; both of these experiments were done in coincidence with protons detected near 180°. A multiple-detector NaI(Tl) array was also used in the same reaction geometry for better γ-ray detection efficiency. Mean lifetimes of 12 levels from 2727 to 3161 keV are reported. Spins and sometimes parities of the following levels were deduced from the angular-correlation analyses and lifetime results: 1885 keV, $\frac{7}{2}^-$; 2199 keV, $\frac{7}{2}^{(-)}$; 2311 keV, $(\frac{13}{2})$; 2366 keV, $\frac{9}{2}^-$; 2727 keV, $\frac{7}{2}$; 2823 keV, $\frac{9}{2}$. Multipole mixing ratios and M1 and E2 transition rates of the radiations from these and from the 1292-keV level are presented. The similarity of the low-lying level structure and of interlevel transitions in ^{55}Mn to those in certain other $f_{\frac{7}{2}}$ nuclei is examined. (auth)

6493 INTERNAL BREMSSTRAHLUNG IN THE UNIQUE FIRST FORBIDDEN ELECTRON CAPTURE DECAY OF ^{41}Ca. Myslek, B. Sujkowski, Z.; Zylicz, J. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Phys.; A215: No. 1, 79-84(1973).

The spectrum of internal bremsstrahlung photons was measured for the unique first-forbidden decay of ^{41}Ca. The experimental shape factor essentially deviates from the theoretical ones; also, the overall photon intensity per K capture is higher than predicted. (auth)

6494 ^{57}Fe(n,γ)^{58}Fe REACTION. Kopecky, J.; Abrahams, K.; Stecher-Rasmussen, F. (Reactor Centrum Nederland, Petten, Netherlands). Nucl. Phys.; A215: No. 1, 45-53(1973).

The circular polarization of γ rays from the capture of polarized thermal neutrons in an isotopically enriched target of ^{57}Fe was measured. The analysis of 19 primary transitions resulted in unambiguous spin assignments for 14 bound states of ^{58}Fe. For five of these, at E_x = 4.02, 4.14, 4.32, 4.36, and 4.44 MeV, all with $J^\pi = 1^+$, no spin assignments have been reported previously. The γ-ray energies and intensities of these transitions were measured. The ^{57}Fe(n,γ) reaction Q value was determined to be 10044.6 ± 1.0 keV. A significant correlation between the (d,p) strength and the (n,γ) reduced transition strength was found for p-bound states with E_x = 0 to 5 MeV. (auth)

6495 γ DECAY OF LOW-LYING STATES IN ^{44}Sc. Dracoulis, G. D.; Durell, J. L.; Gellatly, W. (Univ. of Manchester, Eng.). J. Phys., A (London); 6: No. 11, 1772-1799(Nov 1973).

Levels in ^{44}Sc have been studied using the reactions ^{44}Ca(p,nγ)^{44}Sc, ^{41}K(α,nγ)^{44}Sc and ^{28}Si(^{18}O,p$n\gamma$)^{44}Sc. The level scheme up to 1.5 MeV has been established. Lifetimes have been measured using the Doppler shift attenuation method and the recoil distance method. γ ray angular distributions were measured near threshold in the (p,n) reaction and these results together with the lifetimes and branching ratios allow spin assignments to be made for most of the states. The low-lying negative parity states are interpreted as deformed bands, co-existing with the spherical positive parity states predicted by the shell model. (auth)

6496 STUDY OF ^{42}Sc USING THE ^{40}Ca(α,d)^{42}Sc REACTION. Thomas, M. F. (Univ. of Minnesota, Minneapolis); Skouras, L. D. J. Phys., A (London); 6: No. 11, 1763-1771(Nov 1973).

States of T = 0 in ^{42}Sc were populated via the ^{40}Ca(α,d)^{42}Sc reaction at a bombarding energy of 25.5 MeV. Deuteron angular distributions were measured to the states at 0.61 MeV ($1^+ + 7^+$), 1.491 MeV (3^+) and 1.511 MeV (5^+). The relative strengths of states up to an excitation of 3.03 MeV were measured and compared with the predictions of a model which considered excitation of the ^{40}Ca core. Reasonable agreement is found for states up to 2.27 MeV. The results are consistent with the 1.846 MeV level being the $J^\pi = 3^+$ head of a deformed band but not with the level at 2.391 MeV being the 4^+ member of this band. (auth)

6497 SPECTRUM OF PHOTOPROTONS FROM ^{26}Mg. Varlamov, V. V.; Ishkhanov, B. S.; Kapitonov, I. M.; Kocharova, Zh. L.; Piskarev, I. M.; Shevchenko, O. P. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 99-100(5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 170-172(5 Aug 1973).

An investigation of the spectrum of the photoprotons from the nucleus ^{26}Mg, obtained with the aid of bremsstrahlung with maximum energy E_γ = 32.0 MeV is reported. The experimental results are analyzed on the basis of data on the cross section for the photoproton reaction on the nucleus ^{26}Mg and data on the positions of the excited states of the final nucleus ^{25}Na. (auth)

6498 PROXIMITY SCATTERING AND SINGLET DEUTERON IN THE REACTION ^{40}Ca(d,np)^{40}Ca. Gemmeke, H. Heidelberg; Univ. Heidelberg (1973). 67p. (In German).

Thesis.

In the investigation of n-p proximity scattering, a singlet deuteron mixture (^{1}d) could lead to a false interpretation of the experimental data. In order to determine the ^{1}d-share, the following measurements with deuteron injection energies of 5.2 to 8.3 MeV were carried out on the already previously examined cascade reaction ^{40}Ca(d,n)^{41}Sc$_{3.48p}$ ^{40}Ca: excitation function of the cascade, elastic scattering of the deuterons on ^{40}Ca and the energy dependence of the n-p final state interactions. Azimuthal n-p angle correlations were recorded at a fixed polar angle $\Theta_n = \Theta_p = 70°$. A Monte-Carlo calculation was used for the data reduction in order to consider the experimental border conditions as accurately possible. From the measurements, an upper limit of the ^{1}d-intensity in the proximity region can be obtained. It is shown that in the given case, the total d-break-up including singlet deuteron share can have a maximum value of 15% of the proximity scattering intensity. (GE)

6499 DOORWAY STATE STRUCTURE IN ^{41}Sc. Tang, J. C. N.; Legge, G. J. F. (Univ. of Melbourne). J. Phys., A (London); 6: No. 11, L156-L160(Nov 1973).

Inelastic proton scattering to the 5·609 MeV 4^- state of ^{40}Ca displays a cluster of fine structure resonances with similar angular distributions and with outgoing widths modulated according to the expectations for a strongly mixed doorway state of configuration $\{[(1d_{\frac{5}{2}})^{-1}(1f_{\frac{7}{2}})]_{4^-}(2p_{\frac{1}{2}})\}_{\frac{9}{2}^+}$. (auth)

6500 EXCITATION OF GIANT MONOPOLE RESONANCES BY PROTON SCATTERING. Satchler, G. R. (Oak Ridge National Lab., TN). Particles Nucl.; 5: No. 4, 105-118(Apr 1973).

Data from proton inelastic scattering to the giant resonance region are examined for evidence of the excitation of an isoscalar monopole breathing mode. Two slightly different models for the interaction are constructed and studied. The currently available data are compatible with such a monopole excitation whose strength exhausts the energy-weighted sum rule, although the quadrupole interpretation is somewhat to be preferred. Asymmetry measure-

ments on the excitation by polarized protons could easily distinguish between these two possibilities. The asymmetries predicted for monopole excitation are sensitive to the deformation of the spin-orbit coupling. (auth)

6501 MICROSCOPIC CALCULATIONS FOR (p,n) REACTIONS TO ISOBARIC ANALOGUE STATES. Rickertsen, L. D.; Kunz, P. D. (Univ. of Colorado, Boulder). Phys. Lett., 47B: No. 1, 11-15(15 Oct 1973).

Calculations of (p,n) transitions to 0^+ isobaric analog states were made taking into account the (p,d) (d,n) contribution as well as the usual charge exchange. Satisfactory agreement in shape between calculated and experimental angular distributions is obtained over a broad range of target nuclei and proton energies and the resulting strengths needed to reproduce magnitudes are much more consistent than when the two-step mechanism is omitted. (auth)

6502 MONOPOLE TRANSITIONS IN INELASTIC ^{3}He SCATTERING ON Ti ISOTOPES. Morsch, H. P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 47B: No. 1, 21-23(15 Oct 1973).

Inelastic ^{3}He-scattering to the lowest excited 0^+ states in ^{46}Ti and ^{48}Ti was measured at 29 MeV. The strongly structured angular distributions are well reproduced by a microscopic description using $[(s_{\frac{1}{2}}d_{\frac{5}{2}})^{-2^m} f_{\frac{7}{2}}^{n+2m}]$ and $[f_{\frac{7}{2}}^{n-2m} p_{\frac{3}{2}}^{2m}]$ particle-hole configurations. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 6477, 6479, 6481, 6491, 6500, 6501, 6518, 6534, and 6605.

6503 (FRNC-TH-200) STUDY OF THE DECAY OF ^{56}Co AND EXCITED LEVELS OF ^{56}Fe. Calvino, A. M. (Nice Univ., 06 (France)). 1971. 180p. (In French). INIS.

Thesis.

Simple and coincidence γ ray spectra measurements were used to study the decay of ^{56}Co; 14 gamma transitions having the following energies were identified: 263.9, 411.5, 487.7, 486.6, 655.3, 674.5, 853.1, 996.7, 1088.9, 1159.7, 1198.6, 1272.2, 1640.4, and 3369.5 keV, together with the following lines whose existence has not yet been confirmed 1797.2, 2273.6, 2310.4, 2362.2, 2657.8, and 2960.1 keV. The measurements confirmed the existence of the following excited levels of ^{56}Fe: 846.7, 2084.7, 3122.4, 4048.7, 4100.0, 4119.9, 4297.7 and 4457.8 keV. An attempt was made to analyze the ^{56}F level scheme. In this scheme, families of collective levels are observed adjacent to a certain number of intrinsic levels. These families resemble the quasi-rotational bands found for numerous nuclei which are not very deformed. The recent theory of Mariscotti, Scharff-Goldhaber and Buck can be used to interpret this phenomenon. (auth)

6504 (HMI-B-137, pp 51-52) MAGNETIC MOMENTS OF EXCITED NUCLEAR STATES. (In German).

6505 (HMI-B-137, pp 53-54) ISOMERIC STATES IN ^{66}Ga AND ^{68}Ga. Leitz, W.; Mahnke, H. E.; Semmler, W.; Sielemann, R.; Wichert, T. (In German).

6506 (INR-1464, pp 12-13) CROSS SECTIONS OF THE (n,p) REACTION AT E_n = 14.6 MeV FOR SEVERAL NUCLIDES. Dresler, J.; Araminowicz, J.; Garuska, U. (Univ. of Lodz, Poland). 1973.

6507 (NP-19852, pp 84-86) G-FACTOR MEASUREMENT OF THE 8^+ STATE IN ^{86}Sr PRODUCED IN Kr GAS. Hashimoto, O.; Matthias, E.; Nakai, K.; Nagamiya, S.; Recknagel, E.; Yamazaki, T.; Yamazaki, Y. Dec 1972.

6508 Cu(n,γ) REACTION. Kopecky, J.; Stecher-Rasmussen, F.; Abrahams, K. (Reactor Centrum Nederland, Petten, Netherlands). Nucl. Phys.; A215: No. 1, 54-60(1973).

The circular polarization of γ rays from capture of polarized thermal neutrons in natural Cu was measured. The analysis of 16 primary transitions yields unique spin assignments for two ^{64}Cu levels, and limits the possible spin values for eight other ^{64}Cu levels and three ^{66}Cu levels. No correlation between the (d,p) strength and the (n,γ) reduced transition strengths was found. (auth)

6509 FINITE-RANGE CALCULATIONS OF THE j DEPENDENCE OF (^{12}C, ^{11}B) AND (^{16}O, ^{15}N) ON ^{62}Ni. Charlton, L.A. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. Lett. 31: No. 2, 116-118 (9 July 1973).

Full finite-range calculations, including recoil effects exactly, have been performed for single-proton-transfer reactions on ^{62}Ni. Projectiles of ^{16}O and ^{12}C are considered. It is found that the ratios of cross sections leading to the ground and first excited states in ^{63}Cu are in good agreement with the experiment. This is not true when recoil is neglected. (auth)

6510 STUDIES ON THE LEVEL SCHEME OF ^{66}Zn, ^{144}Sm AND ^{120}Sn USING THE (γ,γ') REACTION. Szichman, H. (Soreq Nuclear Research Center, Yavne, Israel). Z. Phys.; 259: No. 3, 217-225 (1973).

The decay schemes from highly excited levels in ^{66}Zn, ^{144}Sm and ^{120}Sn reached via the (γ,γ') reaction were investigated using a nickel capture γ source. The level schemes deduced are presented. Measurements of the angular distributions of the scattered radiation permitted determination of the spins of the low-lying levels in these nuclei. The reduced strength of the transitions show that they are predominantly E1. The total radiation width of the 8,995 keV resonant level in ^{144}Sm was re-evaluated and found to be 73 ± 15 MeV. (auth)

6511 SOME APPLICATIONS OF THE CORE-COUPLING MODEL. Hoffmann-Pinther, P. H. Athens, OH; Univ. of Ohio (1973). 153p. University Microfilms Order No. 73, 25,746.

Thesis (Ph.D.).

The purpose of the present work is to describe in the core-coupling model (of Thankappan and True) the low-lying states of some odd-A nuclei and one odd-odd nucleus in the A < 100 region, and to obtain wave functions which may be used to calculate electric and magnetic transitions and moments in these nuclei. The nuclei studied were ^{89}Y, ^{85}Sr, and ^{95}Y, and the odd-A nickel isotopes, $^{59-65}$Ni; the Ni isotopes were treated in the quasi-particle formalism. The energy spectrum, appropriate spectroscopic factors, B(E2) values, and wave functions were obtained. (RWR)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 4933, 5688–5690, 5732, 5951, 6477, 6491, 6501, 6504, 6510, 6511, 6541, 6542, 6544, 6566, 6605, and 6625.

6512 (AD-732286) MEASUREMENT OF NEUTRON CROSS SECTIONS FOR PRODUCTION OF ISOMERIC NUCLEI INCLUDING THE EFFECT OF A NONUNIFORM NEUTRON FLUX. Head, J. H. (Air Force Academy, Colo. (USA)). Aug 1971. 29p. (USAFA-RR-71-8). NTIS.

All the mathematical derivations and results needed to calculate neutron cross sections from experimental data obtained by activation analysis are presented in detail. The complexities that arise from the production and detection of isomeric nuclei are discussed. Nonuniform neutron fluxes are analyzed by considering a series of short time intervals during which the flux can be considered constant. General expressions for the metastable and ground-state reaction cross sections are presented, and several specialized applications of these general results are described. (GRA)

6513 (CONF-730568-(Abstr.)) BELGIAN SOCIETY OF PHYSICS GENERAL SCIENTIFIC MEETING, UNIVERSITY OF GHENT, MAY 24–25, 1973. Summary of Communications. (Ghent Rijksuniversiteit (Belgium)). 1973. 83p. (In several languages).

The meeting was divided into four sessions, with the following numbers of papers: atomic and molecular physics and physics of plasmas, 28; physics of elementary particles, 9; solid-state physics, 18; and nuclear physics, 20. Abstract-length contributions appear in Dutch, French, and English. (RWR)

6514 (EANDC(E)-157(U)(Vol. 2)) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN THE EUROPEAN COMMUNITY, FOR THE PERIOD JANUARY 1–DECEMBER 31, 1972. (European American Nuclear Data Committee). May 1973. 101p. (In French and English). Dep. NTIS (U. S. Sales Only) $7.25.

Brief reports containing some new data from eleven institutions in France, Italy, and Belgium are presented. Fission and radiative capture are among the nuclear reactions which are included. (RWR)

6515 (HMI-B-137, pp 77-78) LIFETIME AND g FACTOR OF THE $11/2^-$ STATE IN ^{113}Sn.

6516 (INR-1464) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN POLAND, MAY 1972–APRIL 1973. Marcinkowski, A. (comp.). (Institute of Nuclear Research, Warsaw (Poland)). 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

This report contains only information on research which is closely related to the activities of the International Data Committee of the International Atomic Energy Agency in the field of neutron physics. Six of the papers have been title listed in NSA; the remaining item has already been accepted for publication. (RWR)

For title listing of individual papers see: 6506, 6517, 6518, 6541, 6565, and 6595.

6517 (INR-1464, pp 9-11) CROSS SECTIONS FOR FAST NEUTRON INDUCED REACTIONS IN ^{107}Ag AND ^{109}Ag ISOTOPES. Augustyniak, W.; Marcinkowski, A. (Inst. of Nuclear Research, Warsaw). 1973.

6518 (INR-1464, pp 14-18) INVESTIGATION OF THE (n,2n) REACTION WITH 14.6-MeV NEUTRONS. Araminowicz, J.; Dresler, J. (Univ. of Lodz, Poland). 1973.

6519 (NP-19852, pp 30-32) GAMMA TRANSITION FROM THE FIRST 3$^-$ LEVELS IN ^{94,96,98,100}Mo. Inanaga, T.; Kamitsubo, H.; Fujisawa, T.; Wada, T.; Koike, M.; Pingel, K. Dec 1972.

6520 (NP-19852, pp 33-34) INELASTIC SCATTERING OF DEUTERONS BY EVEN Mo ISOTOPES. Wada, T.; Kamitsubo, H.; Fujisawa, T.; Koike, M.; Inanaga, T. Dec 1972.

6521 (NP-19852, pp 53-57) MECHANISM OF (^{3}He,t) REACTION. Toyama, M. Dec 1972.

6522 (ORNL-TM-4390, pp 9-10) TOTAL NEUTRON CROSS SECTIONS OF THE ISOTOPES OF ZIRCONIUM. Good, W. M.; Harvey, J. A.; Hill, N. W. Nov 1973.
In report to the U. S. Nuclear Data Committee.

6523 (ORNL-TM-4406) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH TIN FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.75 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T A.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 55p. Dep. NTIS $4.75.
Numerical values of differential cross sections for gamma rays produced by neutron reactions with tin were obtained for neutron energies between 0.75 and 20 MeV for θ_γ = 125 deg. The $d^2\sigma/d\omega dE$ values were obtained using a NaI spectrometer. These data consist of neutron and gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for 0.7 ≤ E_γ ≤ 10.5 MeV, with gamma-ray intervals ranging from 20 keV for E_γ ≤ 1 MeV to 160 keV for E_γ ~ 9 MeV. Neutron energy intervals varied from 0.25 MeV for E_n = 0.75 to 2 MeV to 3 MeV for E_n = 14 to 20 MeV. (auth)

6524 (ORO-3346-124) NUCLEAR AND X-RAY SPECTROSCOPY WITH RADIOACTIVE SOURCES. Ninth Annual Progress Report. Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). 31 Oct 1973. Contract AT(40-1)-3346. 32p. Dep. NTIS $3.75.
Research on nuclear and x-ray spectroscopy with radioactive sources is summarized. (JFP)

6525 (ORO-3491-21, pp 18-21) SCATTERING OF 142-MeV ALPHA PARTICLES FROM ^{40}Ca AND ^{90}Zr. Burdzik, G. E.; Goldberg, D. A.; Smith, S. M. Oct 1973.
In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6526 (RD/B/M-2747) CURRENT STATUS OF FISSION PRODUCT DATA. Davies, B. S. J.; Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.
The current status of available data on fission products is discussed. The most recently published set of data compiled at Berkeley Nuclear Laboratories is described in some detail and is used to illustrate the accuracy and completeness of available data. It is found that most of the data needed to calculate decay heating from fission products are well known where the half-life is longer than seconds. Most of the unknown data needed to produce a complete set for all known nuclides relates to nuclides with half-lives in the range 1–100 seconds. The improvement in the quality of fission product decay data in recent years has made it possible to gather together a data set which is of sufficient quality to enable many of the requirements for decay heating calculations to be satisfied. However, on a nuclide-by-nuclide basis, many more measurements are needed before all aspects of the data are clarified. (UK)

6527 OBSERVATION OF THE SIGN OF THE NUCLEAR QUADRUPOLE INTERACTION BY β-γ DIRECTIONAL CORRELATIONS. Raghavan, R.S.; Raghavan, P.; Kaufmann, E.N. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 31: No. 2, 111-113 (9 July 1973).
We have demonstrated for the first time the possibility of determining the sign of the nuclear quadrupole interaction by β-γ directional correlations in a noncubic single crystal. A simple time-differential measurement on the 828-keV level of ^{115}In populated by the allowed (Gamow-Teller) β decay of ^{115}Cd yields the value of the quadrupole interaction of this level in a single crystal of Cd metal to be $e^2qQ/h = +146(5)$ MHz. (auth)

6528 MEASUREMENT OF THE QUADRUPOLE MOMENTS OF THE FIRST $\frac{1}{2}^-$ AND $\frac{5}{2}^-$ STATES OF ^{109}Ag BY COULOMB EXCITATION. Thomas, D. J.; Hall, I.; Throop, M. J.; Wakefield, B. (Univ. of Liverpool). J. Phys., A (London); 6: No. 10, 1571-1579 (Oct 1973).
The quadrupole moments of the 311 keV ($\frac{3}{2}^-$) and 415 keV ($\frac{5}{2}^-$) states of ^{109}Ag have been measured by the method of comparison of Coulomb excitation probabilities with two bombarding ions. The quadrupole moments of both states are negative, and at least that of the 311 keV state is large. (auth)

6529 (p,t) REACTION STUDIES ON SOME EVEN ISOTOPES OF SAMARIUM. Oelert, W. (Univ., Hamburg). Z. Phys.; 259: No. 3, 263-267 (1973).
The (p,t) reaction on the even isotopes ^{144}Sm, ^{148}Sm and ^{150}Sm has been investigated at an incident proton energy of 25.5 MeV. Angular distributions have been measured for transitions to the ground state and excited states up to an excitation energy of about 2.5 MeV. Especially the L = 0 angular distributions are discussed. (auth) (GE)

6530 DECAY OF ^{116g}In. Fettweis, P.; Sadasivan, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Z. Phys.; 259: No. 3, 195-204 (1973).
The decay of the 1$^+$, 14s ground state of ^{116}In produced by neutron capture has been re-investigated using Ge(Li) detectors. It is found that besides the ground state of ^{116}Sn, excited levels at 1293.6 (2$^+$), 1756.9 (0$^+$), 2225.3 (2$^+$), 2545.7 (0$^+$, 1$^+$, 2$^+$), 2649.8 (2$^+$), 2790.7 (2$^+$) and 2844.6 (2$^+$) keV are populated, while no evidence could be obtained for the population of the 0$^+$ and 2$^+$ levels at 2030 and 2112.4 keV, respectively. The activation cross section for ^{116m2}In (2.16s, I$^\pi$ = 8$^-$) has been deduced as 83 ± 8b. (GE)

6531 NUCLEAR PARAMETERS OF THE 140 keV MOESSBAUER LEVEL IN ^{99}Tc FROM MOESSBAUER SPECTROSCOPY. Shenoy, G. K.; Abstreiter, G.; Kalvius, G. M.; Schwochau, K.; Linse, K. H. (Technische Univ., Munich/Garching, Ger.). J. Phys., A (London); 6: No. 10, L144-L147 (Oct 1973).
Moessbauer resonance spectra of the 140 keV transition in ^{99}Tc were measured in a variety of source and absorber combinations over the temperature range from 1.6 to 65°K. The following parameters were obtained from these spectra: $\Delta\langle r^2\rangle \simeq 6 \times 10^{-3}$ fm^2, $T_{\frac{1}{2}}(140) = 237 \pm 14$ ps and $g(140) = 1.03 \pm 0.25$. (auth)

6532 TIME OF X-RAY EMISSION BY FRAGMENTS OF FIXED CHARGES. Donichkin, A. G.; Solov'ev, S. M.; Eismont, V. P. (Radium Inst., Leningrad). Yadern. Fiz.; 18: No. 2, 270-276 (Aug 1973). (In Russian).
Number and energy distribution are measured of x-ray quanta recorded by a detector from stopped and moving (to the detector and from it) fragments. Comparing the intensities of the separate spectral lines one is able to determine the emission time for various charges. It is found that near the shell Z = 50 something less times correspond to the even charges. This fact is related to the lesser yield of x rays from fragments with even charges and is, likely, evidence of a picture with exhausted lower excitation levels of even-even nuclei near the close shells. (auth)

6533 ENERGY RELEASE FROM FISSION PRODUCTS. Tobias, A. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Energy; 27: No. 10, 725-739 (Oct 1973).
A simple method has been used to estimate mean beta and gamma decay energies of the short lived fission products, for which only half-life measurements and total decay energy estimates are available. This has enabled calculations to be made of beta and gamma decay heating from fission products which are in agreement with experimental results to better than 10% for decay times as short as 1 sec. Calculated beta and gamma decay energy following a long irradiation of ^{235}U (thermal fission) is found to reproduce to better than 3% a currently accepted curve of beta + gamma decay energy (SHURE, 1961) following an infinite irradiation of ^{235}U, for decay times 1 ≤ t ≤ 10^9 sec. These calculations also gave values B (∞,0) = 6.60 MeV/fission, G(∞,0) = 6.56 MeV/fission and D(∞,0) = 21.44 MeV/fission for the total beta, gamma and total kinetic energy release respectively, from thermal neutron fission of ^{235}U. Comparisons are made with the calculations

of ENGLAND (1970). The idea, implicit in the results of ENGLAND'S calculations, that reactor systems have been underdesigned with respect to decay heat removal is rejected. The present calculations also show that the code FISP, together with its data library, provide a reliable means of estimating fission product decay energy release at all decay times after fission. (auth)

6534 GAMMA-RAY ENERGIES AND RELATIVE INTENSITIES OF ^{76}Se, ^{108m}Ag, ^{113}Sn, ^{131}I, AND ^{133}Ba. Inoue, H.; Yoshizawa, Y. (Hiroshima Univ.). J. Phys. Soc. Jap.; 34: No. 6, 1437-1442 (Jun 1973).

Gamma-ray energies lower than 500 keV and relative intensities have been precisely measured with Ge(Li) detectors. Many experimental effects such as the source position effect, the counting rate effect, the room temperature effect, etc. are examined. Results are as follows: 303.916 ± 0.012 and 400.624 ± 0.030 keV for ^{76}Se; 433.932 ± 0.014 keV for ^{108m}Ag; 255.126 ± 0.010 (3.33 ± 0.13) and 391.686 ± 0.027 keV (100) for ^{113}Sn; 364.456 ± 0.031 keV for ^{131}I; 161 (0.98 ± 0.07), 223 (0.76 ± 0.05), 276 (11.6 ± 0.5), 302.839 ± 0.008 (29.6 ± 1.1), 355.999 ± 0.024 (100) and 383.841 ± 0.027 keV (14.9 ± 0.6) for ^{133}Ba. Parentheses show relative intensities. (auth)

6535 RESONANCE AND THERMAL-NEUTRON TOTAL CROSS SECTIONS FOR PROMETHIUM-147 AND PROMETHIUM-148m. Kirouac, G. J.; Eiland, H. M.; Conrad, C. A.; Slovacek, R. E.; Seemann, K. W. (Knolls Atomic Power Lab., Schenectady, NY). Nucl. Sci. Eng.; 52: No. 3, 310-320(Nov 1973).

Resonance parameters for ^{147}Pm and ^{148m}Pm were determined, and the resonances in ^{147}Pm were analyzed up to 317 eV. Only one resonance was observed for ^{148m}Pm; its location at 0.17 eV is important for thermal reactor calculations. Transmission measurements were initially made on four samples of $^{147}Pm_2O_3$ containing 1.6% of the decay product ^{147}Sm. Later measurements, made on a mixed sample of (^{148m}Pm + ^{147}Pm)$_2O_3$ and on ^{147}Sm, provided resonance parameters for ^{148m}Pm and an opportunity for a complete reevaluation of the previous ^{147}Pm results. Corrections for the samarium content could also be made. Both shape and area analyses were performed. The measured total cross section for ^{147}Pm at 0.025 eV was 198 ± 8 b and a capture resonance integral of 2280 ± 200 b was calculated. Using the parameters of the ^{148m}Pm resonance at 0.17 eV, a corresponding total thermal-neutron cross section of 10,600 b was obtained. Integral measurements with cadmium-covered samples gave a value of $(3.6 \pm 2.4) \times 10^3$ b for the resonance integral of ^{148m}Pm, thereby setting an upper limit of 6,000 b. (auth)

6536 E5 TRANSITION IN ^{123}Te AND E5 TRANSITIONS IN GENERAL. Raman, S.; Auble, R. L.; Milner, W. T. (Oak Ridge National Lab., TN). Phys. Lett.; 47B: No. 1, 19-20(15 Oct 1973).

An extremely weak 248 keV, E5 transition in ^{123}Te was observed with a strength of 0.05 Weisskopf units. The available experimental information on all E5 transitions was also summarized. (auth)

6537 ^{93}Nb(n,2n)^{92}Nb CROSS-SECTION AT 14 MeV EXTRACTED FROM EXPERIMENTAL NEUTRON EMISSION SPECTRUM. Hermsdorf, D.; Sassonoff, S.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden). J. Nucl. Energy; 27: No. 10, 747-750(Oct 1973).

Information on the ^{93}Nb(n,2n)^{92}Nb reaction at 14.6 MeV was obtained from measurements of neutron emission spectra and its analysis taking into account the compound nucleus emission and emission during the precompound phase of the reaction. A value of ~1200 mb was obtained for σn, 2n confirming recent analysis that the activation cross section of ~450 mb should be considerably increased with important consequences for design of fusion reactor blankets, where Nb is a preferred material. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 6477 and 6568.

6538 (AREAEE-165) EPITHERMAL RESONANCE INTEGRAL OF LUTETIUM. Abul-Ela, E.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The epithermal resonance integrals (RI_{et}) for ^{176}Lu and ^{175}Lu were calculated. They are obtained by adding together the epithermal-subcadmium resonance integral (RI_{es}) and the epicadmium resonance integral (RI_{ec}). The energy region is thus divided into two parts, the first part of which lies between thermal cut-off (E_{et}) and cadmium cut-off (E_{ec}), whereas the second part lies between cadmium cut-off and infinity. In the calculation of the epithermal-subcadmium resonance integral the neutron spectrum used was represented by four different joining functions, namely Δ_1, Δ_2, Δ_3, and Δ_4. For the epicadmium resonance integral, the theoretical calculations were compared with results of measurements made by the cadmium ratio method, and good agreement was obtained. The results were presented as a ratio of RI_{et}/RI_{ec} for the four joining functions used and for different neutron temperatures ranging from 200°K to 900°. (1 figure, 4 tables) (auth)

6539 (FRNC-TH-397) USE OF RADIOACTIVE DECAY FOR THE IDENTIFICATION OF THE EXCITED STATES OF 93-, 91-, AND 89-NEUTRON ISOTOPES OF DYSPROSIUM. Torres, J. P. (Paris-11 Univ., 91, Orsay (France)). 1972. 110p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis.

The chain of the 89-, 91-, and 93-neutron isotopes of dysprosium was studied using the radioactive decay of the corresponding holmium isotopes. The chains are: ^{155}Er(5.3 min) → ^{155}Ho(48 min) → ^{155}Dy(10.2 h) → ^{155}Tb(5.4 d) → ^{155}Gd(stable); ^{157}Er(5.3 min) → ^{157}Ho(12.6 min) → ^{157}Dy(8.1 h) → ^{157}Tb(150 a) → ^{157}Gd(stable); ^{159}Er(36 min) → ^{159}Ho(33 min) → ^{159}Dy(144 d) → ^{159}Tb(stable). The level schemes were established for ^{157}Dy and ^{155}Dy, and the level scheme of ^{159}Dy was completed. A systematic comparison of the results obtained with the method to those obtained from (d,p), (d,t) and (α,xnγ) reactions enabled the identification of almost all the excited states observed in the framework of the Nilsson model. Account must be taken of a strong Coriolis interaction in view of explaining the sequence of positive-parity levels. In the case of the 89-neutron isotope (^{155}Dy) the Coriolis coupling must be taken into account, between the negative-parity levels $3/2^-(521)$, $3/2^-(532)$ and $5/2^-(523)$ and also between the positive-parity levels $1/2^+(660)$, $3/2^+(651)$ and $5/2^+(642)$. (FR)

6540 (HMI-B-137, pp 41-43) INVESTIGATION OF SHELL-MODEL WAVE FUNCTIONS WITH THE HELP OF THE REACTIONS ^{13}C(τ,p)^{15}N AND ^{17}O(τ,p)^{19}F. Lettau, H. (In German).

6541 (INR-1464, pp 1-8) DIFFERENTIAL CROSS SECTIONS FOR 18-MeV NEUTRON INDUCED REACTIONS ON THE ^{147}Sm, ^{149}Sm, ^{151}Eu, ^{161}Dy, AND ^{165}Ho. Glowacka, L.; Jaskola, M.; Kozlowski, M.; Osakiewicz, W.; Turkiewicz, J.; Zemlo, L. (Inst. of Nuclear Research, Warsaw). 1973.

6542 (NP-19852, pp 66-69) GAMMA-DECAY OF ^{146,150,152}Sm FOLLOWING THE (α,2n) REACTION. Hashizume, A.; Tendow, Y.; Katou, T.; Kumagai, H. Dec 1972.

6543 (TI-707-130-26) EVALUATION OF ^{182}W, ^{183}W, ^{184}W, AND ^{186}W CROSS SECTIONS FOR THE ENDF/B DATA FILE. Rose, P. F.; Otter, J. M.; Ottewitte, E. (Atomics International, Canoga Park, Calif. (USA)). 18 Jul 1973. Contract AT(04-3)-824. 167p. Dep. NTIS $10.50.

Neutron cross section data for ^{182}W, ^{183}W, ^{184}W, and ^{186}W were re-evaluated at Atomics International for the ENDF/B IV library. A complete set of neutron cross section data was prepared for each nuclide for incident neutron energies between 10^{-5} eV and 20 MeV. These data in ENDF/B format are available from the National Neutron Cross Section Center at Brookhaven National Laboratory. (49 figures, 26 tables, 104 references) (auth)

6544 ROTATIONS AND INTRINSIC $K^\pi = 1^+$ EXCITATIONS IN DEFORMED RARE-EARTH NUCLEI. Kammuri, T.; Kusuno, S. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A215: No. 1, 178-188(1973).

The $K^\pi = 1^+$ intrinsic excitations in deformed rare-earth nuclei are studied in the framework of the random-phase approximation, which excludes the spurious state (zero-energy excitation) related with the rotation of the whole nucleus. The Nilsson-plus-pairing, quadrupole, and spin-dependent (magnetic dipole or spin-quadrupole) force model is taken. Cranking-model formulas for the moment of inertia and the collective gyromagnetic ratio are derived as the zero-energy limit of the lowest $K^\pi = 1^+$ excited states to the ground state of ^{170}Yb are also calculated. The M1 transition strengths are concentrated almost below 6 MeV, while the E2 ones are scattered even up to 12 MeV. Several levels around 12 MeV show rather strong E2 transitions of $\Delta N = 2$ character. (auth)

6545 APPLICATION OF SUPERFLUID HYDRODYNAMICS TO NUCLEAR ROTATION. Landi, G.; Matera, F. (Univ., Florence). Lett. Nuovo Cim.; 8: No. 9, 557-562(27 Oct 1973).

Nuclear rotation is described from a macroscopic point of view, started from a generalization of the hydrodynamic model along the lines of superfluid hydrodynamics. In particular the method used by Landau and Lifshitz used to explain the effective density of rotating He II is followed. Plots are shown for dysprosium-158, erbium-160, and -162, and ytterbium-166. (JFP)

6546 MEASUREMENT OF THE NEUTRON CAPTURE CROSS SECTION OF HOLMIUM-165 AND GOLD-197. Czirr,

J. B.; Stelts, M. L. (Univ. of California, Livermore). Nucl. Sci. Eng.; 52: No. 3, 299-309(Nov 1973).

As part of a continuing program to accurately measure neutron capture cross sections, data for ^{165}Ho and ^{197}Au were obtained in the 167-eV to 0.6-MeV energy range. All capture reactions are measured relative to the fission rate of ^{235}U for neutron energies above 800 eV and to the ^{10}B(n,$\alpha_0 + \alpha_1$) reaction below 13 keV. In addition, current best estimates of $\sigma_f(^{235}U)$ and $\sigma_{n,\alpha}(^{10}B)$ are used to convert these ratios to up-to-date capture cross sections. The 3.9-eV "black resonance" of ^{165}Ho is used to normalize all cross sections. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 5168, 5689, 6477, 6500, 6504, 6518, 6546, 6573, 6605, 6615, and 6616.

6547 (COO-3236-6, pp 24-25) SEARCH FOR EXTINCT NATURAL RADIOACTIVITY OF ^{205}Pb. Lancet, M. S. 31 May 1973.

In nuclear chemistry and geochemistry research.

A more sophisticated estimate of the production rate ratio, $p(^{205}Pb/^{204}Pb) \sim 2$, was determined. (CES)

6548 (LUNP-7307) ALPHA-PARTICLES FROM ^{197}Au IRRADIATED BY 500-MeV BREMSSTRAHLUNG. Adler, J. O.; Andersson, G.; Gustafsson, H. A. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Kaernfysik; Lund Univ. (Sweden). Fysiska Institutionen). Jun 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

The energy and angular distributions of alpha-particles in the reaction ^{197}Au(γ,α) were measured at nine different angles for bremsstrahlung with peak energy 500 MeV. The measurements were made using a telescope consisting of three Si surface-barrier detectors. The experimental results are compared with cascade-evaporations calculations and the angular distributions indicate the presence of directly-emitted α-particles in competition with evaporated. (auth)

6549 (NP-19852, pp 73-75) MAGNETIC MOMENTS OF HIGH-SPIN ISOMERIC STATES IN Po ISOTOPES. Yamazaki, Y.; Hashimoto, O.; Nagamiya, S.; Nomura, T.; Nakai, K.; Yamazaki, T. Dec 1972.

6550 (NP-19852, pp 80-83) ALPHA- AND GAMMA SPECTROSCOPY OF N = 128 ISOTONES: ^{216}Ra, ^{217}Ac, AND ^{218}Th. Nomura, T.; Hiruta, K.; Inamura, T.; Odera, M.; Hashimoto, O. Dec 1972.

6551 (ORO-3491-21, pp 138-145) LINEAR MOMENTUM TRANSFER IN REACTIONS OF 140-MeV ^{4}He IONS WITH HEAVY ELEMENTS. Meyer, W. G.; Minor, M. M.; Roche, C. T.; Viola, V. E. Jr. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6552 (ORO-3491-21, pp 146-154) FISSION FRAGMENT ANGULAR DISTRIBUTIONS FROM INTERMEDIATE-ENERGY ^{4}He-ION INDUCED REACTIONS. Viola, V. E. Jr.; Roche, C. T.; Meyer, W. G.; Clark, R. G. Oct 1973.

In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6553 NUCLEAR SPECTROSCOPIC INVESTIGATIONS OF THE STRUCTURE OF ^{215}Po AND ^{219}Rn. Ley, L. Bonn; Univ. Bonn (1971). 72p. (In German).

Thesis.

The lifetimes of the 272- and the 402-keV levels in polonium-215 were measured with the following results: $T_{\frac{1}{2}}$ (272) = (195 ± 15) × 10^{-12} sec and $T_{\frac{1}{2}}$ (402) = (66 ± 11) × 10^{-12} sec. The thus derived M1 and E2 transition probabilities can be explained within the framework of the core excitation model. For Rn 219, the multipolarity was determined from the measured conversion electron spectra, which results in the necessity of revising all spin excited states determined so far. The measured lifetimes in Rn 219 are: 14.4 keV: $T_{\frac{1}{2}}$ = (875 30) × 10^{-12} sec and 4.4 keV: $T_{\frac{1}{2}}$ = (1.54 1.3) × 10^{-9} sec and imply collective properties of these nuclear states. (GE)

6554 ^{207}Pb(d,p)^{208}Pb REACTION WITH HIGH RESOLUTION. Vold, P. B. (Univ. of Bergen, Norway); Andreassen, J. O.; Lien, J. R.; Graue, A.; Cosman, E. R.; Duennweber, W.; Schmitt, D.; Nuesslin, F. Nucl. Phys.; A215: No. 1, 61-78(1973).

The reaction ^{207}Pb(d,p)^{208}Pb was studied at E_d = 18.0 MeV using the MPI Heidelberg Emperor tandem accelerator and multiple-gap spectrograph. The average resolution of 18 keV was better than previous measurements; and this, combined with the long beam exposure, allowed many finer details of the neutron particle–hole structure of ^{208}Pb to be examined. In all, 45 levels were seen up to E_x = 6.3 MeV, many of which were never seen before. A DWBA analysis of the stripping transitions angular distributions is made, and values of $(2J + 1)S_{lj}$, energy centroids, and summed strengths are given. An interesting cluster of $1i_{\frac{13}{2}}$ and $2g_{\frac{9}{2}}$ levels at $E_x \approx 4.2$ MeV is resolved and compared to recent isobaric analog state data. A search for weak stripping strength to known pairing vibrations in ^{208}Pb gave essentially negative results, and points to the need for improved ultraresolution measurements. (auth)

6555 LOW-LYING ONE-PROTON, THREE-NEUTRON-HOLE STATES IN ^{206}Bi. Fujioka, M.; Kanbe, M.; Hisatake, K. (Tokyo Institute of Technology, Ohakayama, Meguro-ku, Tokyo, Japan). Phys. Rev. Lett. 31: No. 2, 114-116 (9 July 1973).

Precision conversion-electron and γ-ray measurements have revealed a strong M1 transition of 10.84 keV between the first and the second excited states of ^{206}Bi, resulting in a substantial revision of the previous decay scheme of ^{206}Po. Thus it has become possible to interpret some of the low-lying states in ^{206}Bi in terms of one-proton, three-neutron-hole configurations, in correspondence with the one-proton, one-neutron-hole multiplets in ^{208}Bi. (auth)

6556 NEW ABSOLUTE DETERMINATION OF THE α PARTICLE ENERGY OF ^{210}Po. Gorman, D. J.; Rytz, A. (Bureau International des Poids et Mesures, Sevres, France). Compt. Rend., Ser. A, B; 277: No. 1, 29-31(2 Jul 1973). (In French).

The absolute energy of the principal α line of ^{210}Po was determined using semicircular spectrography in a uniform 0.8T induction field. There were 14 measurements made on 4 sources prepared by vacuum evaporation. The mean result obtained was E_α = 5304.51 ± 0.07 keV. (auth)

6557 NUCLEAR SPREADING WIDTHS OF PARTICLE-VIBRATION $(1/2)^+$ DOORWAY RESONANCES IN ^{207}Pb AND ^{209}Pb. Divadeenam, M. (Duke University and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706); Beres, W.P. Phys. Rev. C 8: No. 3, 1123-1127 (Sept 1973).

The nuclear spreading widths of the ^{208}Pb and ^{209}Pb $(\frac{1}{2})^+$ doorway resonances are calculated in a particle-vibration model. The hallway states are of the particle-two-phonon type. The fine structure in ^{207}Pb is essentially due to the availability of many hallways (some with large matrix elements) and their proximity to the doorway. The ^{207}Pb and ^{209}Pb $(\frac{1}{2})^+$ doorway spreading widths are found to be in line with the experimental situation. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 5157, 5690, 6533, 6551, 6552, and 6595.

6558 (EANDC (E)-154 (U)) $\bar{\nu}$, THE AVERAGE NUMBER OF EMITTED NEUTRONS IN FISSION. Ribon, P. (ed.). (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1973. 111p. (CONF-721148-).

From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

Separate abstracts were prepared for each of the complete papers in this report. (RWR)

For abstracts of individual papers see: 5157, 6559–6564, and 7191.

6559 (EANDC(E)-154(U), pp 14-18) REVIEW OF THE ENERGY-DEPENDENT $\bar{\nu}$ VALUES FOR THE HEAVY ISOTOPES (Z ≥ 90) FROM THERMAL TO 15 MeV AND OF $\bar{\nu}$ VALUES FOR SPONTANEOUS FISSION. Manero, F. (IAEA, Vienna). Mar 1973.

From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

A thorough compilation was performed of all available measurements until October 1972, either as published material or from private communications, on the energy dependent $\bar{\nu}$ values for prompt and delayed neutrons from thermal to 15 MeV, for heavy isotopes with Z ≥ 90, as well as for the $\bar{\nu}$ values for spontaneous fission. A detailed analysis is included also on the present situation of the $\bar{\nu}_t$ values for thermal fission of the fissile isotopes and for the spontaneous fission of californium-252, which are normally used as standard. (JFP)

6560 (EANDC(E)-154(U), pp 20-24) STATUS OF THE EVALUATION OF $\bar{\nu}$ TOTAL FOR ^{252}Cf BY THE IAEA 'NTER-

NATIONAL WORKING GROUP. Axton, E. J. Mar 1973.
From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

The values of $\bar{\nu}$ for californium-252 are traced through from the original publications; the changes, if any, that were made by the 1969 and 1972 IAEA 2200 ms^{-1} review panels are indicated. (JFP)

6561 (EANDC(E)-154(U), pp 28-42) FLUCTUATIONS OF $\bar{\nu}$ IN THE RESOLVED NEUTRON RESONANCE REGION OF ^{239}Pu. Shackleton, D. (CEN, de Saclay, Gif-sur-Yvette, France); Trochon, J.; Frehaut, J.; Le Bars, M. Mar 1973.
From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

Fluctuations from resonance to resonance of the fission neutron multiplicity $\bar{\nu}$ and prompt gamma-ray energy E_γ were measured for neutron-induced fission of ^{239}Pu up to 250 eV. The neutron multiplicity and gamma-ray energy were measured using the same large-volume liquid scintillator, used in conjunction with a fast fission chamber. An observed anticorrelation between fluctuations of these two quantities is attributed to the role of the $(n,\gamma f)$ reaction. (auth)

6562 (EANDC(E)-154(U), pp 44-66) FISSION MULTIPLICITY MEASUREMENTS ON ^{233}U AND ^{235}U AT RPI. Reed, R. L.; Hockenbury, R. W.; Block, R. C. Mar 1973.
From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

The relative $\bar{\nu}$ values over the thermal and resonance energy regions of uranium-233 and -235 were measured. Resonances were resolved up to 30 eV for uranium-235 and 100 eV for uranium-233. (JFP)

6563 (EANDC(E)-154(U), pp 67-90) RECENT RESULTS IN ν_p MEASUREMENTS BETWEEN 1.5 AND 15 MeV. Frehaut, J.; Mosinski, G.; Soleilhac, M. (Centre d'Etudes, Bruyeres-le-Chatel, France). Mar 1973.
From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

A precise measurement (1.5% relative error) of $\bar{\nu}_p$ for fission induced in ^{240}Pu by neutrons of energy between 1.5 and 15 MeV was carried out. The presence of ^{235}U and ^{240}Pu in the same fission chamber enabled one to deduce their relative fission cross sections. Furthermore, the simultaneous measurement of $\bar{\nu}_p$ for ^{235}U and ^{240}Pu showed up a systematic error in previously published results of $\bar{\nu}_p$ for ^{235}U, ^{238}U, and ^{239}Pu between 1.3 and 8 MeV. Also, results of a precise measurement of $\bar{\nu}_p$ for the spontaneous fission of ^{240}Pu, are presented. (auth)

6564 (EANDC(E)-154(U), pp 91-108) DIRECT EVALUATION OF $\bar{\nu}(E)$ IN THE GIANT DIPOLE REGION BY MEANS OF A QUASI-MONOCHROMATIC PHOTON BEAM. Veyssiere, A.; Beil, H.; Bergere, R.; Carlos, P.; Lepretre, A. (CEN, Saclay, France). Mar 1973.
From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

A new data-analyzing technique has made possible the separate and simultaneous evaluation of partial photo-neutron cross sections, $\sigma(\gamma,n)$ and $\sigma(\gamma,2n)$, together with photofission cross sections, $\sigma(\gamma,f)$, of ^{232}Th, ^{238}U, and ^{237}Np. Raw experimental data were obtained using a "quasi-monochromatic" photon beam created by the annihilation in-flight of monochromatic positions. By using the same technique a direct evaluation of $\bar{\nu}(E)$ for an incident photon energy, E_γ corresponding to the excitation energy, E, of the fissile target nucleus also becomes possible. (auth)

6565 (INR-1464, pp 21-26) EXCITATIONS OF FISSILE NUCLEI BY RADIATIONLESS TRANSITIONS IN MUONIC ATOMS. Evseev, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR); Kozlowski, T.; Mamedov, T.; Roganov, V. S.; Sujkowski, Z.; Wojtkowska, J.; Zglinski, A. 1973.

6566 (JINR-P1-7399) π^0-MESON PRODUCTION IN π^-–Xe INTERACTIONS AT 3.5 GeV/c. Pluta, J.; Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The characteristics of π^0-meson production in π^-–Xe interactions at 3.5 GeV/c are given. (auth)

6567 (JINR-P2-7295) ANGULAR DISTRIBUTIONS OF PARTICLES FROM INCLUSIVE HADRON-NUCLEUS REACTIONS AND THE SCALING IN SUPERHIGH ENERGY REGION. Eliseev, S. M.; Murzin, V. S.; Sarycheva, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the account of secondary interactions in the nucleus-target and the use of events of known energy give the possibility to coordinate the data on cosmic rays at $T \geq 10^4$ GeV and those from accelerators and to obtain new ones in the region of superhigh energies. (auth)

6568 (JINR-P7-7410) SYNTHESIS OF SUPERHEAVY ELEMENTS. Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The problems of synthesis of superheavy elements in the nuclear reactions with the Ge and Xe ions are considered. It is shown experimentally that in the Th + Ge reaction the production cross section of the superheavy nuclei is less than 10^{-34} cm^2 in their lifetime interval from 5 msec up to one year. A short review of the experimental results on bombarding ^{238}U with the ^{136}Xe ions is given. The perspectives of artificial synthesis of superheavy elements in a new stability region are discussed. (auth)

6569 (LA-1) LOS ALAMOS PRIMER. Serber, R. (Los Alamos Scientific Lab., N. Mex.). Apr 1943. 24p. Dep. NTIS.

The contents of this report are based on a set of five lectures given during the first two weeks of April, 1943, as an "indoctrination course" in connection with the starting of the Los Alamos Project. "The object of the project is to produce a practical military weapon in the form of a bomb in which the energy is released by a fast neutron chain reaction in one or more of the materials known to show nuclear fission." Estimates on the minimum size of the bomb, effects of tamper, damage that could be caused by the bomb, efficiency, detonation, probability of predetonation, and mechanics of shooting are among the topics included. (4 figures) (RWR)

6570 (NP-19852, pp 49-52) TOTAL ENERGY SURFACE FOR ^{236}U IN THE TWO-CENTER MODEL. Yamaji, S.; Suekane, S.; Harada, K. Dec 1972.

6571 (ORNL-TM-4390, pp 11) MEASUREMENT OF THE ^{235}U FISSION CROSS SECTION AT THE ORELA 150-METER FLIGHT-PATH STATION FOR NEUTRON ENERGIES BETWEEN 2 keV AND 100 keV. Perez, R. B.; de Saussure, G.; Silver, E. G.; Ingle, R. W.; Weaver, H. Nov 1973.
In report to the U. S. Nuclear Data Committee.

6572 (ORO-3491-21, pp 155-157) ANGULAR DISTRIBUTIONS OF SELECTED FRAGMENTS FROM FISSION OF ^{238}U AND ^{209} Bi. Aras, N. K.; Gordon, G. E.; Viola, V. E. Jr. Oct 1973.
In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6573 (ORO-3491-21, pp 165-170) ALPHA DECAY OF VERY NEUTRON-DEFICIENT ACTINIDE NUCLEI. Schuster, P. A.; Viola, V. E.; Clark, R. G. Oct 1973.
In 1973 progress report for the experimental study of the structure of nuclei and the interactions of intermediate energy particles.

6574 (T-743, pp 3.65-3.99) EMISSION OF LONG-RANGE AND LIGHT-CHARGED NUCLEI IN THE N-THERMAL FISSION AND RELATED TOPICS. Cambiaghi, M.; Cavallari, F.; Fossati, F.; Jappelli, F.; Petronio, C.; Pirelli, T. (Univ., Pavia, Italy). 1972.
From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).
In TRIGA Owners' Conference.

The energy spectra and yields of various long-range particles released in the n-thermal fission of uranium-233, and -235 and plutonium-239 were found. The measurements of energy spectra of the fission fragments and particles in coincidence were performed in the case of californium-252 spontaneous fission. Distinct distributions were obtained for the emission of tritium and helium-6 and -4 respectively. Angular distributions relative to the flight direction of the light fragments were measured for helium-4 and -6 particles released in the fission of plutonium-239. (JFP)

6575 (UCID-16359) CALCULATION OF RESONANCE SELF SHIELDING IN ^{235}U. Plechaty, E. F.; Cullen, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jun 1973. Contract W-7405-Eng-48. 10p. Dep. NTIS $3.00.

Analytic and Monte Carlo calculations of the Bramblett–Czirr ^{235}U transmission experiment [Nucl. Sci. Eng. 35, 350-357 (1969)] were performed. The number of fissions from the uncollided flux could be calculated as a function of depth. The results of experiment and Monte Carlo calculations are tabulated and plotted; fission and total cross sections for ^{235}U are shown. In view of the agree-

ment between the analytic and Monte Carlo calculations, it appeared that the ENDF/B-III cross sections were inadequate to calculate the Czirr–Bramblett experiment. (3 figures, 2 tables) (RWR)

6576 (UNIOSAKA-1973-1) INTERMEDIATE RESONANCES IN THE NEUTRON TOTAL CROSS SECTION OF ^{235}U AT LOW ENERGIES. II. Kitazoe, Y.; Suzuki, H.; Sekiya, T. (Osaka Univ., Suita (Japan). Faculty of Engineering). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The validity of the intermediate resonance model applied previously is investigated in a more systematic way. The investigation takes into account many resonance levels and ranges over a wider energy region (E = 0 to 1 MeV). The intermediate resonance model reproduces well both the observed cross section at high energies (E > 60 eV) and average cross sections at lower ones (E < 60 eV), and clarifies a close relation between these two cross sections. (3 figures, 3 tables) (auth)

6577 TRANSFER REACTIONS IN THE INTERACTION OF ^{40}Ar WITH ^{232}Th. Artukh, A. G.; Gridnev, G. F.; Mikheev, V. L.; Volkov, V. V.; Wilczynski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A215: No. 1, 91-108(1973).

Transfer reactions in the bombardment of a ^{232}Th target with 297- and 388-MeV ^{40}Ar ions were studied. The energy spectra, angular distributions, and cross sections for the formation of products having atomic numbers $5 \leq Z \leq 20$ were measured. In the energy spectra of the reaction products broad peaks having energies in the vicinity of the output Coulomb barrier height were observed along with the quasi-elastic ones. The dependence of the partial angular distribution of the light products on the reaction Q value was determined. The observed partial angular distributions were analyzed by applying the Strutinsky model. The total cross sections of light product formation were found to be 1100 mb and 2400 mb for the ^{40}Ar energies E = 297 MeV and E = 388 MeV, which give the values of the critical angular momentum of 102 ħ and 94 ħ, respectively, for the two cases. (auth)

6578 FLUXES OF NEUTRONS GENERATED BY HIGH-ENERGY PROTONS IN THICK BLOCKS OF URANIUM. Barashenkov, V. S.; Toneev, V. D. At. Energ. (USSR); 35: No. 3, 163-168 (Sep 1973). (In Russian).

The multiplication of particles in large blocks of uranium bombarded by protons of energy T = 300 to 700 MeV is considered using the Monte-Carlo method. In a block of ^{238}U, about 65 neutrons, on the average, are produced for a primary proton of energy T = 700 MeV. If a natural mixture of uranium isotopes (0.72% ^{235}U) is used, the yield of neutrons increases by almost a quarter. The yield of neutrons may be increased also as a result of homogeneous admixture of light elements along the ionization path length in uranium. Data on heat release in the blocks are presented and certain conclusions drawn regarding neutron multiplication under the action of a beam of high energy deuterons. (10 figures, 2 tables, 5 references) (auth)

6579 FISSION CROSS SECTION OF PLUTONIUM-238. Silbert, M. G. (Los Alamos Scientific Lab., NM); Moat, A.; Young, T. E. Nucl. Sci. Eng.; 52: No. 2, 176-186(Oct 1973).

The neutron-induced fission cross section of ^{238}Pu was measured from 18 eV to 3 MeV. The nuclear explosion Persimmon provided an intense, single-pulse neutron source spanning an energy range of more than five decades. Neutrons from this underground source were sorted by time of flight over a 304-m vertical path, and interacted with a ^{238}Pu sample and with flux monitors at ground level. The neutron flux was measured relative to the reactions $^{3}He(n,p)$, $^{6}Li(n,\alpha t)$, and $^{235}U(n,f)$. Fission cross-section areas are reported for 49 resonances below 500 eV. A number of previously unobserved resonances are reported, yielding an average level spacing of 9.5 ± 0.7 eV. There is strong evidence for intermediate structure in the fission cross section with an average spacing of ~1 keV. (4 figures, 5 tables) (auth)

6580 NEUTRON CAPTURE CROSS SECTION OF PLUTONIUM-238: DETERMINATION OF RESONANCE PARAMETERS. Silbert, M. G. (Los Alamos Scientific Lab., NM); Berreth, J. R. Nucl. Sci. Eng.; 52: No. 2, 187-200(Oct 1973).

The radiative capture cross section of ^{238}Pu was measured from 18 eV to 200 keV neutron energy. A time-of-flight experiment with a 306-m flight path was carried out in conjunction with the underground nuclear explosion Persimmon. Fission-fragment detectors viewed a thin ^{238}Pu target to measure the fission cross section, while modified Moxon–Rae detectors viewed a second, thicker ^{238}Pu target to measure the gamma-ray emission. Subtraction of the fission gamma-ray contribution from the Moxon–Rae signal yielded the contribution due to radiative capture. Single-level area analysis of the measured fission and capture cross sections gave values for the neutron and fission widths of 49 resonances below 500 eV, under the assumption of a known, constant radiative capture width. The s-wave neutron strength function $\langle \Gamma_n^0/D \rangle$ was determined to be $(1.27 \pm 0.25) \times 10^{-4}$. The derived fission widths exhibit a distinct maximum near 300 eV neutron energy. At higher energies, the fission-to-capture ratio shows pronounced intermediate-structure peaks, attributed to second-well effects in the fission barrier. (10 figures, 2 tables) (auth)

6581 NEUTRON AND GAMMA SPECTRA IN DELAYED NEUTRON DECAY OF SOME FISSION PRODUCTS. Folger, H. (Univ., Mainz); Franz, H.; Grimm, W.; Hermann, G.; Kratz, J. V.; Kratz, K. L.; Nuh, F.; Prussin, S. G. (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

By use of fast radiochemical separation methods, (separation time: 24 sec), several short-lived isotopes of As, Se, Br, Te, and I were isolated from ^{235}U fission products and identified as emitters of delayed neutrons. With the new high pressure, high resolution $^{3}He(n,p)$ spectrometers, the delayed neutron spectra of ^{85}As ($T_{\frac{1}{2}}$ = 2.0 sec) and ^{87}Br ($T_{\frac{1}{2}}$ = 55 sec) were measured along with the gamma spectra up to energies above the neutron binding energy. The results are discussed under the following aspects: systematics of the neutron emission probabilities, preferred population of energy levels in β^--decay within the range of high level density, competition of neutron and gamma emission, neutron-emitting decay into excited energy states of the daughter nuclide. (GE)

6582 URANIUM-233 FISSION NEUTRON SPECTRUM FROM 0.8 TO 10 MeV. Green, L.; Mitchell, J. A.; Steen, N. M. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 52: No. 3, 406-412(Nov 1973).

The ^{233}U fission neutron spectrum was measured by pulsed-beam time-of-flight techniques from 0.8 to 10 MeV. Above ~2 MeV, the data were found, within statistics, to be adequately represented by either the model in the ENDF/B-III file or a best fit Maxwellian distribution with nearly the same average energy. At lower energy, the data appear to follow the ENDF/B representation somewhat more closely. The fit of a Maxwellian distribution to the ^{233}U data yielded an average "temperature" parameter of 1.34 ± 0.02 MeV, where the error includes both statistical and systematic uncertainties. A similar fit to data taken for a ^{235}U sample yielded a temperature parameter of 1.31 ± 0.03 MeV; however, the best estimated difference in temperature is 16 ± 6 keV. (auth)

6583 NEUTRON–FISSION COMPETITION NEAR THRESHOLD: THE INFLUENCE OF SHELLS AND PAIRING ON THE DECAY OF THE ^{241}Cm COMPOUND NUCLEUS. Metag, V. (Univ. of Copenhagen); Lee, S. M.; Liukkonen, E.; Sletten, G.; Bjoernholm, S.; Jensen, A. S. Nucl. Phys.; A213: No. 2, 397-412(1973).

The excitation functions of the reactions $^{239}Pu(\alpha,2n)$ and $^{241}Am(p,2n)$, both leading to ^{240}Cm under fission competition, are measured between threshold and 8 MeV excess energy. The two identical excitation functions show a bump-like structure 5 MeV above threshold which is impossible to explain by the use of statistical reaction theories with standard level density expressions. A compound reaction calculation based on shell dependent level densities for the neutron and fission channels, respectively, with the inclusion of pairing leads to a detailed understanding of the observed structure. (auth)

6584 TRANSFORMATION OF A SET OF MULTILEVEL RESONANCE PARAMETERS INTO AN EQUIVALENT SET OF SINGLE-LEVEL PSEUDOPARAMETERS AND A SMOOTH BACKGROUND. de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 52: No. 3, 412-416(Nov 1973).

A method is described to transform a set of multi-level resonance parameters into an equivalent set of single-level pseudoparameters and a "smooth background." The method utilizes a Kapur-Peierls expansion of the cross sections and does not necessitate "refitting" of the data; it is illustrated by an example. (auth)

6585 ENERGY LEVELS OF URANIUM-235 AND PLUTONIUM-239. Satyanarayana, U.; Ramamurty, S. (Andhra Univ., Waltair, India). Nucl. Sci. Eng.; 52: No. 3, 417(Nov 1973).

The low lying energy levels of ^{235}U and ^{239}Pu are well fitted by a two-parameter formula due to Holmberg and Lipas. (auth)

6586 NUCLEON/CHARGE REDISTRIBUTION AND THE ASYMMETRY IN FISSION. Nair, R. K.; Ellis, W. H. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 17: 119-120 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6587 SHORT-LIVED FISSION PRODUCT CHARACTERIZATION USING GAMMA EMISSIONS AND FISSION RECOIL RANGES. Norman, J. (Gulf General Atomic Co., San Diego, CA); Katekaru, J.; Scott, D.; Winchell, P.; Black, S. Trans. Amer. Nucl. Soc.; 17: 125-126(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6588 CALCULATION OF RESONANCE SELF SHIELDING IN ^{239}Pu AND ^{235}U. Cullen, D. E.; Plechaty, E. F. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 490-491(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6589 INTERMEDIATE STRUCTURE IN THE NEUTRON-INDUCED ^{235}U CROSS SECTIONS. James, G. D.; de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 495-496(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6590 POSSIBLE AMBIGUITIES OF REACTION WIDTHS IN AN R-MATRIX PARAMETRIZATION. Adler, D. B.; Adler, F. T. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 17: 496-497 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6591 THERMAL SCATTERING CROSS SECTIONS OF ^{233}U AND ^{232}Th. Green, L.; Mitchell, J. A. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 17: 497-498 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6592 PRODUCTION OF DELAYED PHOTONEUTRONS FROM ^{235}U IN HEAVY-WATER MODERATOR. Baumann, N. P.; Currie, R. L.; Pellarin, D. J. (E.I. duPont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 499-500(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6593 MEASUREMENT OF FISSION PRODUCT YIELDS FROM ^{232}Th IN A ^{252}Cf FISSION NEUTRON SPECTRUM. Deen, J. R.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 17: 531-532(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6594 TESTING OF ^{234}U PHOTON PRODUCTION DATA FROM ENDF/B MATERIALS 58, 702, AND 4187. Ford, W. E. III. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 545-546 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Theory

Refer also to abstracts 6175, 6196, 6237, 6309, 6400, and 6487.

6595 (INR-1464, pp 27-37) PENETRABILITY OF NUCLEAR FISSION BARRIER FOR MUONIC ATOMS. Blocki, J.; Sujkowski, Z.; Zielinska-Pfabe, M. (Inst. for Nuclear Research, Swierk, Poland). 1973.

6596 (JINR-E4-7294) DEPENDENCE OF THE $\frac{1}{2}^+$ STATE DENSITY NEAR THE NEUTRON BINDING ENERGY ON THE MASS NUMBER. Malov, L. A.; Soloviev, V. G.; Stoyanov, Ch.; Vdovin, A. I.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

The semi-microscopic approach, taking into account the energies of the one-quasiparticle and phonon components, is used to calculate the average spacing between the $I^\pi = \frac{1}{2}^+$ states in spherical and deformed nuclei in the region $139 \leq A \leq 205$ at the neutron binding energy B_n and at an energy 6.5 MeV. A rather good description of the $\frac{1}{2}^+$ state density at the neutron binding energy is obtained, and its dependence is shown in agreement with experiment. It is also shown that the theory describes rightly a strong increase of D in the transition from deformed nuclei to spherical ones, an increase of D as approaching the magic nuclei and small variations of D in deformed nuclei. (auth)

6597 (JINR-P6-7281) PERSPECTIVES OF DEVELOPMENT OF SOME ACTUAL PROBLEMS OF EXPERIMENTAL NUCLEAR PHYSICS. Hrynkiewicz, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

A short review is made of some interesting problems in low energy nuclear physics. Special attention is paid to the perspectives of development of investigations on the beams of light charged particles and heavy ion accelerators. (auth)

6598 (NP-19852, pp 47-48) EFFECT OF EXCHANGE CURRENTS ON ORBITAL G-FACTORS. Yamaji, S.; Hirata, M.; Fujita, J. Dec 1972.

6599 (UNIOSAKA-1973-2) STUDY ON THE HIERARCHY OF NUCLEAR REACTION STATES. Kitazoe, Y.; Suzuki, H.; Sekiya, T. (Osaka Univ., Suita (Japan). Faculty of Engineering). 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

The hierarchy of nuclear reaction states is investigated through a theoretical description and its applications to the evaluations of total neutron cross sections. The investigation is useful for understanding the detailed structure of resonance reactions which proceed from simple mechanism states into complicated mechanism ones. The present formula explains very well some observed resonance cross sections which the R-matrix formula does not reproduce satisfactorily. These cross sections are typical cases where the antisymmetrization of wave functions contributes explicitly to the resonance cross sections because of the hierarchy of the reaction states. (4 figures, 2 tables) (auth)

6600 RESTRAINTS ON THE DETECTION OF RESONANCE PARAMETER CORRELATIONS IN THE FLUCTUATION REGION. Klein, G.; Paetz gen. Schieck, H. (Univ., Cologne). Nucl. Phys.; A215: No. 1, 24-28(1973).

Cross correlations of fluctuating excitation functions need not be sensitive to even the strongest correlations of resonance parameters. This is shown to be due to the influence of direct contribution phases. (auth)

6601 REALIZATION OF THE PARTICLE–HOLE CONJUGATION OPERATOR IN THE SHELL MODEL. Mueller-Arnke, A. (Argonne National Lab., IL). Nucl. Phys.; A215: No. 1, 205-212 (1973).

A quasi-spin representation of the particle–hole conjugation operator in one j shell is given. Extension to the case of protons and neutrons allows a similar representation for the conjugation between a proton and a neutron hole. This is useful in the discussion of a symmetry property of systems self-conjugate under this conjugation. (auth)

6602 $K = \frac{1}{2}$ ROTATION SPECTRUM IN ODD-A NUCLEI. Inglis, D. R. (Univ. of Massachusetts, Amherst). Nucl. Phys.; A215: No. 1, 189-196(1973).

The striking behavior of the rotational levels of $K = \frac{1}{2}$ bands in deviating from regularity by tending to cluster into doublets is widely understood in terms of the change in the energy of collective rotation induced by the coupling to the particle angular momenta and involving the intricacies of the rotation functions D^J_{MK}. It is derived for a special case as a manifestation of the true Coriolis influence of the rotation on the particle energy in a way to emphasize the essential simplicity of the effect. (auth)

6603 NUCLEAR RESPONSE FUNCTION. Bertsch, G.F. (Department of Physics, Cyclotron Laboratory, East Lansing, Michigan, 48823). Phys. Rev. Lett. 31: No. 2, 121-124 (9 July 1973).

A fast numerical method is described for calculating nuclear excitation properties with δ-type interactions. The method is applied to ^{208}Pb, and the following properties of the nucleus are found: (i) The quadrupole strength has two main pieces, one a low state and one identifiable as the giant quadrupole; (ii) excitations with $L > 2$ do not seem to have high-energy collective parts; (iii) the giant dipole $L=2$, $T=1$ is too low unless the interaction has a strong momentum dependence. (auth)

6604 NUMBER AND ANGULAR MOMENTUM PROJECTION FROM HARTREE–BOGOLIUBOV STATES. Allaart, K.; Goeke, K.; Faessler, A. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 263: No. 5, 407-424(1973).

Rotational spectra, calculated by angular momentum projection from Hartree–Bogoliubov states, may be completely distorted by particle number nonconservation. A simple method for correcting this is presented, which brings them close to the number-projected

spectra. It is also shown that by a slight modification of the usual number projection operator this projection may then be executed two times faster and with better numerical accuracy. We study the effect of J and/or N projection before the variation in a constrained Hartree–Bogoliubov model. It is demonstrated that only simultaneous projection of both particle number and angular momentum before the variation is meaningful. Then a more gradual antipairing effect is found than known from previous work. We concluded, however, that the diagonalization of the Hamiltonian in a space of appropriately chosen generator wave functions is preferable to projection before the variation. (3 figures, 5 tables) (GE)

6605 INTRANUCLEAR CASCADE STUDIES OF LOW-ENERGY PION-INDUCED NUCLEAR REACTIONS: POSSIBLE EFFECTS OF THE FINITE LIFETIME OF THE (3,3) ISOBAR. Harp, G. D. (Brookhaven National Lab., Upton, NY); Chen, K.; Friedlander, G.; Fraenkel, Z.; Miller, J. M. Phys. Rev., C; 8: No. 2, 581-593(Aug 1973).

Intranuclear cascade studies were made of low-energy pion-induced nuclear reactions which include the production and subsequent interactions of (3,3) isobars. The results are in fair to excellent agreement with the sparse amount of experimental information now available. Several experiments are outlined which could test the validity of some of the assumptions made in these calculations. (14 figures, 5 tables) (auth)

6606 SINGLE PARTICLE STATES IN NUCLEI. Hodgson, P. E.; Millener, D. J. (Oxford Univ.). Rev. Brasil. Fis.; 2: No. 1, 87-99(Mar 1972).

It is shown that the centroid energies of single-particle states in nuclei with $35 \leq A \leq 65$ may be identified with the eigenvalues of a local Saxon–Woods potential with spin and isospin terms. The experimental data on the single-particle states may be obtained with higher precision using J-dependent sum rules, and these are given for several values of (J_T, L) and applied in detail to the reaction $^{57}Fe(d,p)^{58}Fe$. (INIS)

6607 RANGE DEPENDENCE OF THE ERICSON–ERICSON POTENTIAL. Faeldt, G. (Univ. of Lund, Sweden). Lett. Nuovo Cim.; 8: No. 10, 655-658(3 Nov 1973).

Up to now the case of finite nucleon-nucleon correlation length for pion-nucleus interactions has only been treated in a phenomenological way by multiplying the zero-range limit term by a phenomenological constant which is fitted to the experimental data. It turns out that this constant is very close to one, and this fact was taken as strong evidence for the importance of short-range nuclear correlations. Calculations are reported which show that this is to be expected. The numerical importance of a nonzero correlation length becomes negligible mainly due to the smallness of the s-wave scattering length. (JFP)

6608 MODEL WITH MULTIPOLE AND SPIN-MULTIPOLE FORCES FOR THE STUDY OF HIGHLY EXCITED STATES OF NUCLEI. Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 17: No. 1, 90-102(Oct 1973). (In Russian).

The fundamental equations of the model describing the structure of highly excited states of nuclei are obtained. Interaction between nucleons is represented in the form of an average nuclear field plus interactions leading to the pair correlations of superconducting type and multipole and spin-multipole forces. The interaction of quasiparticles with phonons is taken into account, which gives rise to the complications of the structure of states with the growth of the excitation energy. (auth)

6609 NUCLEAR PHYSICS. Bowler, M. G. International Series of Monographs in Natural Philosophy. Volume 53. Oxford; Pergamon Press (1973). 432p.

Low energy nuclear physics rather than high energy, or elementary particle physics is considered. Nuclear structure at a fairly basic level, spin and static electric and magnetic moments, approached from quantum mechanics rather than through the vector model of angular momentum, nuclear decay: both electromagnetic and beta-decay are treated using quantum mechanics, but without formal field theory, the theory of nuclear reactions: the concepts of cross section and of resonance are treated in detail, self-sustaining nuclear reactions including the nuclear physics of the fission reactor, the nuclear aspects of stellar physics, and a further application of the theory of thermonuclear reactions: the problems of devising a thermonuclear power plant are treated. Isospin is covered including charge independence and isospin in low energy nuclear physics: pion physics, and the physics of strange particles. (UK)

6610 INTRODUCTION TO ATOMIC AND NUCLEAR PHYSICS. Fifth Edition. Semat, H.; Albright, J. R. London; Chapman and Hall (1973). 727p.

The discussion of foundations of atomic and nuclear physics, includes atoms, ions and electrons; the special theory of relativity; the nuclear atom; some properties of electromagnetic radiation; x-rays; waves and particles; elements of quantum mechanics. The discussion of the extranuclear structure of the atom, includes: the hydrogen atom; optical spectra and electronic structure; x-ray spectra; selected applications of quantum physics. Topics on nuclear physics, covers: particle accelerators; beam transport and detecting devices; radioactivity; nuclear reactions; fission and fusion of nuclei; nuclear processes; fundamental particles. (UK)

6611 DIRECT AND COMPOUND PROCESSES IN NUCLEAR REACTIONS. Hodgson, P. E. (Oxford Univ.). Rev. Brasil. Fis.; 2: No. 1, 61-85(Mar 1972).

The theories used to calculate direct and compound nucleus reactions are reviewed, and methods of applying them to analyze reactions to which both types of processes contribute are described. Recent work on intermediate processes is reviewed, in particular those in alpha-transfer reactions, photonuclear reactions, and nucleon transfer reactions. (INIS)

6612 VARIATIONAL METHODS IN A HARMONIC OSCILLATOR BASIS. Payne, G. L.; Schlessinger, L. (Univ. of Iowa, Iowa City). J. Comput. Phys.; 13: No. 2, 266-287(Oct 1973).

The advantages of using variational methods for solving the Schrödinger equation to obtain the binding energy, well depth, wave function, and the potential times the wave function for the excited as well as the ground states of a potential are discussed. To illustrate the variational techniques the problem of a particle bound in a Woods–Saxon well is solved using a harmonic oscillator basis. Upper and lower bounds for both the eigenvalue and the overlap of the approximate eigenfunction with the true eigenfunction are determined. (auth)

6613 CHARGED-PARTICLE SCATTERING IN THE PRESENCE OF A STRONG ELECTROMAGNETIC WAVE. Kroll, N.M. (Department of Physics, University of California, San Diego, La Jolla, California 92037); Watson, K.M. Phys. Rev. A 8: No. 2, 804-809 (Aug 1973).

A simple and convenient approximation is obtained for the multiphoton energy–transfer processes which accompany the scattering of a charged particle by a scattering potential in the presence of a strong external electromagnetic field. It is expressed in terms of the differential elastic–scattering cross section combined with known functions, and is valid when the scattering potential is weak or when the wave frequency is small. A detailed form of the classical limit is obtained. (auth)

6614 FINAL-STATE EFFECTS ON THERMAL-NEUTRON SCATTERING AT HIGH-ENERGY TRANSFER. Gersch, H.A.; Rodriguez, L.J. (School of Physics, Georgia Insititue of Technology, Atlanta, Georgia 30332). Phys. Rev. A 8: No. 2, 905-912 (Aug 1973).

An approximation is developed for nuclear scattering of neutrons from a target of spinless particles of a single isotope. It has the correct limit for large momentum transfer, the impulse approximation, and is calculable in practice if the single-particle momentum distribution, the off-diagonal two-particle density matrix, and the two-body interaction potential of the target atoms are known. An intended application of the theory is to neutron scattering form liquid helium in the moderately-high-momentum-transfer region ($\hbar k \approx 15$ Å^{-1}) presently accessible with reactor neutrons. (auth)

6615 ELASTIC ELECTRON SCATTERING AND MAGNETIC NUCLEAR STRUCTURE. Prewitt, J. F. Athens, OH; Univ. of Ohio (1973). 113p. University Microfilms Order No. 73-25,753. Thesis (Ph.D.).

An accurate method for the calculation of elastic electron scattering from the magnetization and charge distributions of nuclei is presented. The differential cross section for elastic electron scattering from nuclei was calculated in the distorted-wave Born approximation. Phase-shift analysis was used to obtain the scattering from the spherically symmetric part of the nuclear charge density. The scattering from the nuclear magnetization density was then calculated in first-order Born approximation by using electron wave functions distorted by the spherically symmetric part of the nuclear charge density. The accuracy of the calculation was checked by comparing its results, a zero value for the distorting nuclear potential being assumed, with those results obtained in the plane-wave Born approximation. Experimental data available were the differential cross section of elastically scattered 500-MeV electrons from ^{27}Al, elastically scattered electrons of unspecified energy from ^{209}Bi at a momentum transfer of approximately 2.2 fm^{-1}, and elastically scattered 183-MeV and 250-MeV electrons from ^{51}V. The harmonic oscillator single-particle shell model was used to obtain the nuclear magnetization densities. The nuclear charge distributions were obtained with appropriate fits to the Fermi distribution. Calculations of differential cross sections for elastic electron scattering are

presented for the three nuclei ^{209}Bi, ^{51}V, and ^{27}Al. These calculations indicate that under specified kinematical conditions, elastic electron scattering from the nuclear magnetization densities of these nuclei predominates over that from their nuclear charge densities. This predominance appears to be sufficient to determine the applicability of various nuclear models of the magnetization densities. (RWR)

6616 COMPOUND PARTICLE–CORE COUPLED STATES AND DIRECT NUCLEAR PROCESSES. Ayoub, E. E. New Haven; Yale Univ. (1973). 241p. University Microfilms Order No. 73-24,936.

Thesis (Ph.D.).

The formulation and implementation of an empirically relevant and analyzable model for an extended theory of resonance reactions is considered. The model was designed to incorporate explicitly direct–compound interference effects. It was then confronted with ^{208}Pb(p,p')^{208}Pb(2_1^+) experimental differential excitation functions and angular distributions (in the incident proton energy range from 14.2 to 17.3 MeV) measured explicitly for this purpose. The ^{208}Pb(p,p') reaction is the example par excellence of a reaction dramatically modulated by strong direct–compound interference effects. This study demonstrated the feasibility of direct probing of the probability density of a complex dynamical nuclear system. It therefore permitted the empirical validation not only of quantized quantities such as the spin, the parity, and the isotopic spin of a nuclear state, but also of continuous quantities such as the "direct" and "compound" terms of the collision matrix. It demonstrated that resonance–resonance interferences resulting from the overlap of analog states and direct–resonance interferences reflecting the mixing of the analog states with the nonresonant scattering background play a key role in any reproduction of the experimental data. It illustrated how the study of isobaric analog resonances in the region of lead provides a powerful probe for the simultaneous study of two extreme models of nuclear structure: the collective model and the single-particle model. Most importantly, it has presented a unified physical picture in which available information from a variety of reactions is brought together in a coherent and quantitative picture. (Diss. Abstr. Int., B)

6617 T-MATRIX PERTURBATION THEORY IN THE THREE-NUCLEON BOUND STATE. Afnan, I. R.; Read, J. M. (Flinders Univ. of South Australia, Bedford Park). Aust. J. Phys.; 26: No. 4, 449-457(Aug 1973).

A T-matrix perturbation method was used to calculate three-body binding energies for two local potentials. The results obtained indicate that the method provides one of the most attractive ways of solving by computation the three-body bound state problem for realistic interactions. (auth)

6618 NOTE ON INVERSE SCATTERING CALCULATIONS OF ENERGY INDEPENDENT POTENTIALS. Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Sutherland, New South Wales). Aust. J. Phys.; 26: No. 4, 561-565(Aug 1973).

It is shown that a method proposed for determining one single-channel potential from a real scattering phase shift using resonance parameters allows the determination of an energy-independent potential. (auth)

6619 FINITE DEFORMATIONS OF THE NUCLEUS. Tassie, L. J. (Australian National Univ., Canberra). Aust. J. Phys.; 26: No. 4, 433-440(Aug 1973).

Deformations of the nucleus are examined with a model based on the irrotational incompressible motion of an inhomogeneous fluid. Restrictions of previous treatments to small deformations are noted and the model is extended to arbitrary deformations. The particular case of ellipsoidal deformation is considered and compared with experiment. It is concluded that the contribution of ellipsoidal deformation to hexadecapole deformation is not negligible. (auth)

6620 ORIGIN OF ELECTRIC QUADRUPOLE ENHANCEMENTS IN A = 17 NUCLEI. Harvey, M.; Khanna, F. C. (Chalk River Nuclear Labs., Ont.). Phys. Lett.; 47B: No. 1, 8-10 (15 Oct 1973).

Deformation effective charges (for proton and neutron) needed to fit experiment are shown to satisfy $\eta_p > \eta_n$, if one allows for 2-hole 3-particle admixtures into the A = 17 wave functions. The values of η_p and η_n are consistent with unrestricted Hartree–Fock calculations. (auth)

6621 OFF THE ENERGY SHELL T MATRIX. II. Triplet State. Takemiya, T. (Kumamoto Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1602-1615(May 1973).

The coupled equations of the off-shell Lippman–Schwinger equation for triplet states are solved. From the outgoing-wave parts of the solutions, the expressions of the off-shell T matrices for triplet-state interactions are derived. It is shown that the present T matrices on the energy shell agree with the usual ones and the off-shell T matrices have the symmetry property, $t_{l,l}^{[l]}(\gamma)(p,k;z) = t_{l,l}^{[l]}(\gamma)(k,p;z)$. (auth)

6622 REALISTIC SINGLE-PARTICLE K-MATRIX FOR DEFORMED AND FISSIONING NUCLEI. Kolb, D. (Duke Univ., Durham, NC); Cusson, R. Y.; Harvey, M. Nucl. Phys.; A215: No. 1, 1-23(1973).

A low-order approximation to the Brueckner–Goldman density-dependent single-particle reaction matrix is used. The effective single-particle Hamiltonian is nonlocal and depends on a smeared density. The isospin dependence, spin–orbit, center-of-mass, and Coulomb corrections are performed in a realistic manner. A large orthogonal (spherical/deformed) oscillator basis or a nonorthogonal basis consisting of two overlapping harmonic oscillators is used to diagonalize the Hamiltonian in an iterative self-consistent scheme. The nonlocality, the density-dependent terms, and the Coulomb terms are expanded in Gaussian forms by using a linearized high-speed technique. Results for the total BE, s.p. energies, quadrupole moments, radii, and proton and neutron density distributions of light nuclei are found to be in good agreement with experiment. Fission effects in the reactions ^{8}Be $\rightarrow \alpha + \alpha$ and ^{32}S $\rightarrow {}^{16}$O + ^{16}O are studied. (auth)

6623 PION CONDENSATION IN NUCLEAR AND NEUTRON STAR MATTER. Baym, G. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. Lett. 30: No. 26, 1340-1342 (25 June 1973).

The equilibrium thermodynamic conditions obeyed by a pion condensed system are given. These include the statement that the average spatial currents of conserved quantities must always vanish in the state of lowest free energy, even for π^- condensation into a running-wave mode. The physical significance of pion-condensation thresholds is also discussed. (auth)

6624 EVALUATION OF NUCLEAR POTENTIAL MATRIX ELEMENTS IN THE DEFORMED CARTESIAN BASIS. Allard, J. F. (Institut d'Etudes Nucleaires, Algiers); Medjadi, D. E.; Houssais, B.; Hassan, M. H. J. Comput. Phys.; 13: No. 2, 260-265(Oct 1973).

A method is developed which permits a rapid computation of the nuclear potential matrix elements on the deformed Cartesian basis using the reduced matrix elements $\langle nl|V_{JST}|n'l'\rangle_\omega$ and the brackets $\langle nlm|n_xn_yn_z\rangle$ given by an analytic expression valid for ω_x, ω_y, ω_z, ω being nonequal. The main features concerning the implantation of this method on a computer using the symmetry properties of the calculated terms are also given. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

6625 (RISO-288) PHYSICS DEPARTMENT ANNUAL PROGRESS REPORT, JANUARY 1–DECEMBER 31, 1972. Moeller, H. B.; Christensen, C. J. (eds.). (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 63p. Dep. NTIS (U. S. Sales Only) $5.25.

Research on solid-state physics, plasma physics, nuclear spectroscopy, and meteorology is summarized. (JFP)

Confinement and Heating

Refer also to abstracts 6050, 6613, 6677, 6694, and 6743.

6626 (CEA-N-1599) NUMERICAL SIMULATION OF HEATING BY TRANSIT TIME MAGNETIC PUMPING (T.T.M.P.). Boujot, J. P.; Saussais, J. P. (Compagnie Internationale de Services en Informatique (CISI), Centre d'Etudes Nucleaires de Saclay, 91 - Fig-sur-Yvette (France)). Jan 1973. 19p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The numerical program developed for simulating the heating by transit-time magnetic pumping of a plasma in a tokamak device is described. (FR)

6627 (LA-UR-73-1580) JOULE LOSSES IN LINEAR θ PINCHES: LASER VS MAGNETIC HEATING. Ellis, W. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 9p. (CONF-731114-1). Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The dc joule losses per unit length in a θ-pinch compression coil are calculated and compared to the thermonuclear energy production for two different methods of plasma heating. In the first method, conventional staged θ-pinch heating is assumed. In the second method, laser heating by long wavelength irradiation from the ends is assumed. Reactor parameters are calculated, and it is shown that for circulating power fractions to be 20% or less, the plasma radius must be at least a few cm in size. (auth)

6628 (NP-19861) EXPERIMENTAL STUDY OF ION HEATING BY WAVE MIXING IN AN ELECTRON-CYCLOTRON-RESONANCE PLASMA. Rijnhuizen Report 73-80. de Kock, L. C. J. M. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Sep 1973. 94p. Dep. NTIS (U. S. Sales Only) $6.75.

Thesis. Submitted to Univ. of Utrecht.

An ion heating experiment is described in which the exciting field is produced by the nonlinear interaction of two electromagnetic waves. The waves interact in a region close to electron-cyclotron resonance where efficient interaction is expected. The plasma is sustained by these waves in a simple magnetic bottle. In this experiment, enhancement of ion heating is demonstrated when the beat frequency of the electromagnetic waves is approximately equal to the ion-cyclotron frequency. Maximum overall efficiencies of 1% were obtained. As an explanation, two mechanisms are proposed: modulation of the space-charge potential possible by a loss of electrons on a time scale smaller than the inverse of the modulation frequency and excitation of electrostatic waves by means of a parallel current generated by the modulated $\mu\nabla B$ force acting on the electrons. The electric field generated by either mechanism is efficiently absorbed by ion-cyclotron damping. No significant relation between extra ion heating near the ion-cyclotron frequency and the difference and sum frequency spectra was found. (auth)

6629 ONE REGULARITY OF PLASMA DIFFUSION IN STELLARATORS. Shpigel, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 6-10(1973). (In Russian).

Within the framework of recent assumptions on the collision mechanism of plasma diffusion in toroidal systems, an analysis is made of a series of published experiments on the confinement of plasma in stellarators. Calculations of the diffusion regime carried out in basic theory showed that, in the cases analyzed, the experimentally obtained linear dependence of the duration of plasma confinement on the size of the angle of transformation of the turn of the strong lines of the magnetic field actually should take place. (tr-auth)

6630 EFFECT OF ELECTRIC FIELD ON THE MOTION OF PARTICLES IN A STELLARATOR. Popryadukhin, A. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 11-25(1973). (In Russian).

The motion of particles in the stellarator magnetic field in the presence of electrostatic fields was examined in the drift approximation both for the case when the equipotentials and the magnetic surfaces coincide and in the case of their noncoincidence. It was found in both cases that the electric field leads to a rearrangement of the particles in velocity space. With nonequipotentiality of the magnetic surfaces, large deflections of the particles, driven to increased collision diffusion, are possible. An evaluation was made of the diffusion coefficient. (tr-auth)

6631 GENERATION OF HIGH-POWER LIGHT PULSES AT WAVELENGTHS 1.06 and 0.53 μ AND THEIR APPLICATION IN PLASMA HEATING. I. EXPERIMENTAL INVESTIGATIONS OF REFLECTION OF LIGHT OF TWO WAVELENGTHS IN LASER HEATING OF PLASMA. Basov, N.G.; Zaritskii, A.R.; Zakharov, S.D.; Krokhin, O.N.; Kryukov, P.G.; Matveets, Y.A.; Senatskii, Y.V.; Fedosimov, A.I. Sov. J. Quantum Electron. 2: No. 5, 439-444 (Mar 1973).

The results are given of calorimetric, time, spectral, and polarization measurements of radiation reflected back from a plasma heated by nanosecond laser pulses of $\lambda=1.06$ and 0.53 μ at power densities exceeding 10^{14} W/cm^2 at the target surface. It is shown that the absorption of the $\lambda=0.53$ μ radiation by a plasma is three times as strong as the absorption of the $\lambda=1.06$ μ radiation. (auth)

6632 HOT-ELECTRON PLASMA CONFINEMENT IN THE SUPERCONDUCTING LEVITRON. Anderson, O.A.; Birdsall, D.H.; Hartman, C.W.; Hooper, E.B. Jr.; Munger, R.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. Lett. 31: No. 1, 10-13 (2 July 1973).

Cyclotron resonance heating is used to produce hot ($t\simeq250$ keV) electrons with β up to 10% in axisymmetric torus. The plasma pressure is nearly isotropic. Confinement times of several seconds are achieved, limited by collisions with background gas. Plasma stability is described. (auth)

6633 DRIFT APPROXIMATION FOR PARTICLE MOTION IN THE TORNADO TRAP DEVICE. Kozyrev, A.N.; Peregud, B.P.; Fedichkina, Z.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 17: No. 12, 1923-1927 (June 1973).

Computer calculations are used to find the drift trajectories for particles in the Tornado device when the magnetic field of the trap has a spherical separatrix. It is shown that certain trajectories leave the trap. Estimates for the lifetime, however, lead to values which exceed the time of flight by a factor of $1.5\cdot10^4$, and two orders larger than the measured plasma lifetime. It is also shown that the widths of the bananas are substantially smaller than the Larmor radius. Therefore even a large number of trapped particles should not cause marked changes in the classical transport coefficients. The theoretical results agree qualitatively with experiments on electron confinement. (auth)

6634 HEATING WITH SHORT LASER PULSES. Plis, A.I.; Tyurin, E.L.; Shcheglov, V.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 12, 1995-2000 (June 1973).

We consider problems related to the heating of dense matter by short pulses of laser radiation. The absorption of the energy of the heating laser pulse is considered taking account of reflection for an arbitrary profile. We obtain a relation to determine the most appropriate time for injecting the pulse energy into the absorbing layer formed in a preceding pulse. The problem of heating a two-dimensional solid target by short powerful laser pulses is solved taking account of heat conductivity and gas-dynamic expansion. The neutron yields of the nuclear reaction in D—T and D—D plasmas are calculated. The ratio of the energy of thermonuclear yield $Q_{\text{thermonucl}}$ to the energy of absorbed laser radiation Q is calculated as a function of Q. (auth)

6635 RADIO-FREQUENCY ASSISTED MAGNETIC MIRROR CONFINEMENT OF SINGLY IONIZED POTASSIUM IONS. Van Essen, L. J. Austin, TX; Univ. of Texas (1973). 147p. University Microfilms Order No. 73-26,100.

Thesis (Ph.D.).

A radio-frequency assisted magnetic mirror was used to study the possibility of enhancing particle confinement in a magnetic bottle. A singly ionized, low density beam of K^+ ions was created and directed along the axis of the mirror geometry where a radio-frequency electric field was applied by means of a capacitor plate antenna located near the neck of the bottle. Ion behavior was studied as a function of rf frequency and amplitude for two different magnetic field strengths. For fixed-frequency and low-rf amplitude, all ions escaped. Increasing amplitudes first caused nonadiabatic ion reflection from points behind the resonance, $\omega_{rf} = \omega_c$, and then the loss of all (or most) of the ions to the system's walls. Higher fields caused nonadiabatic reflection to again occur, but this time from points in front of the resonance (theory shows that this latter reflection could have been made adiabatic

had magnetic field strengths approximately three times larger than the experimental field been available). When the rf frequencies were resonant under the peak of the electric field, minimum electric field amplitudes were required to produce this behavior. Finally, numerical solutions for particles trajectories in the experimental geometry were extended for comparison with Watson's adiabatic theory of particle motions. ϵ_{rf}, Watson's energy invariant, was found to remain constant (to within the validity of the theory) and particle reflections were shown to occur with net energy gains of less than 0.05%. (Diss. Abstr. Int., B)

6636 TRAPPING STUDIES OF A LASER PRODUCED PLASMA IN A TOROIDAL QUADRUPOLE MAGNETIC FIELD. Friedman, W. D. Rochester, NY; Univ. of Rochester (1973). 135p. University Microfilms Order No. 73-25,808.

Thesis (Ph.D.).

The trapping of a laser-produced plasma in a toroidal quadrupole magnetic field was studied. The purpose is to determine the conditions required for a laser plasma to fill magnetic confinement geometries of interest to controlled thermonuclear fusion. The plasma is created in the center of the magnetic well from a 100-micron-diameter LiH pellet irradiated in free fall by a high-power (150 MW) Q-switched ruby laser. The major radius of the torus is 17 cm and the field rises to ≈10 kG within 1 cm of the magnetic well. Time-of-flight measurements yield a plasma velocity across the poloidal magnetic field of $\approx 8 \times 10^6$ cm/sec. The quadrupole magnetic field increases the fraction of the target pellet detected as ions from less than 1% in a free expansion, to ≈10% when trapped in the confinement region. In the trapped plasma, double probes give a peak density of $\approx 3 \times 10^{12}$ cm^{-3} and a swept single probe yields peak electron temperatures of 50 eV. A model for the initial plasma–magnetic field interaction is proposed. Order of magnitude calculations support the contention that plasma is transported around the torus by an $\vec{E} \times \vec{B}$ drift in a polarization induced electric field. The laser plasma is compared with a microwave generated plasma in the same torus. Fluctuations are less than 10% in the MHD stable region for both plasmas and the exponential decay times are similar (≈100 μsec). While laser plasmas are a useful tool for studying the confinement properties of toroidal confinement geometries, they are not likely to be used to generate thermonuclear conditions in a magnetically confined plasma without additional heating. (Diss. Abstr. Int., B)

6637 CURRENT HEATING OF DENSE PLASMA DURING COLLECTIVE INTERACTIONS IN HIGH-CURRENT GAS DISCHARGE. Suprunenko, V. A.; Sukhomlin, E. A.; Tolok, V. T. pp 5-15 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of an experimental investigation of the process of origin of the kinetic instability and heating of dense plasma located in a strong electric field are reported. It was found that as a result of the development of high-frequency instabilities, accompanied by anomalous resistance of the plasma and intense microwave radiation from the plasma (at the characteristic frequency significantly lower than the plasma frequency), effective heating of both the electron and ion components of the plasma occurs in the high-current gas discharge. The results obtained are discussed, and an explanation of possible mechanisms of the development of the instabilities is given. (tr-auth)

6638 EFFICIENCY OF CURRENT HEATING IN DENSE PLASMA OF HIGH-CURRENT GAS DISCHARGE. Manzyuk, N. A.; Suprunenko, V. A.; Sukhomlin, E. A.; Ternopol, A. M. pp 20-27 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The physical efficiency of current heating of dense plasma of a high-current gas discharge stabilized with a strong magnetic field was studied. The value of the efficiency of the heating is of the order of 60%. The current heating takes place during the entire time of current flow in the active region of the discharge. The value of the density of the thermal energy of the plasma obtained earlier ($nkT \approx 3 \times 10^{13}$ eV/cm^3) was confirmed. (tr-auth)

6639 CHARGED PARTICLE HEATING OF FUSION PLASMAS. Kammash, T. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 17: 39(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6640 NEUTRAL BEAM HEATING AND ENERGY BALANCE STUDIES FOR CTR TOKAMAKS. Conn, R. W.; McAlees, D. G.; Neil, R. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 39-40(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6641 LASER HEATING OF A DENSE PLASMA PINCH. Chapin, D. L.; Duderstadt, J. J. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 17: 40-41(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6642 FAST FUSION REACTORS: A STEP TOWARD DEMONSTRATING BREAK-EVEN. Husseiny, A. A. (Carnegie-Mellon Univ., Pittsburgh); Sabri, Z. A. Trans. Amer. Nucl. Soc.; 17: 43-44(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Diagnostics

Refer also to abstracts 6665 and 6667.

6643 (CEA-CONF-2388) TWO FREQUENCIES HCN INTERFEROMETER. Belland, P.; Vernon, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd] 4p. (CONF-730906-7) Dep. NTIS (U. S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

The interferometer setup is described. The source is a cw, HCN laser with a power output of 30 mW. The frequency of the reference beam is slightly Doppler-shifted with respect to the probing beam. Using a beat frequency of 10 kHZ, and a 10 MHz electronic clock, a sensitivity of 10^{-2} fringe was obtained. (MOW)

6644 (LRP-65/73) LASER SCATTERING MEASUREMENTS ON A ROTATING MAGNETIC FIELD PINCH. Pietrzyk, Z. A.; Heym, A.; Hofmann, F.; Lietti, A.; Boulanger, P.; Ignat, D. W. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Aug 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Previous investigations of a plasma subjected to a rotating magnetic field are extended to include data from laser light scattering. The electron temperature and density are measured in the center of the discharge as a function of time. The measurements are compared with a MHD model of the experiment. (auth)

6645 (UCRL-74909) TEN-PICOSECOND STREAK CAMERA FOR THE LASER FUSION PROGRAM AT LLL. Thomas, S. W.; Carman, R. L.; Sprackien, H. R.; Tripp, G. R.; Coleman, L. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Sep 1973. 29p. (CONF-730930-5). Dep. NTIS $3.50.

From electro-optical systems design conference; New York, New York, USA (18 Sep 1973).

The development and operation of 10-picosecond streak cameras in the LLL laser fusion program are described. In addition, modifications to two TRW Model 1-D high-speed streak cameras are discussed. The compact cameras are completely self-contained, weigh about 27 kg, and occupy about 1/6 m^2 of bench space. Power consumption is less than 10 W. (auth)

6646 MEASUREMENTS WITH ELECTROSTATIC PROBES IN THE L-1 STELLARATOR. Berezhetskii, M. S.; Grebenshchikov, S. E.; Kossyi, I. A.; Sbitnikova, I. S.; Shpigel, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 82-99(1973). (In Russian).

Methods for electrostatic-probe measurements of the parameters of the plasma injected into the L-1 stellarator with spark sources are described. For measurement of the plasma potential, the electron temperature, the ion temperature, the ion concentration, fluctuating ion beam on the walls of the chamber, and the quasi-permanent ion beam, individual Langmuir probes, emitter probes, multigrid electrostatic probes, and double probes were used. Construction of the probes and the electrical measurement circuit is described. The potential of the methods under conditions characteristic of the L-1 stellarator is discussed. A brief review is given of the basic results of the measurements. (tr-auth)

6647 SUPERHIGH-FREQUENCY METHODS FOR MEASUREMENT OF PLASMA DENSITY IN THE FIAN STELLARATOR. Akulina, D. K.; Nechaev, Yu. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 100-133(1973). (In Russian).

Microwave methods for the measurement of the plasma density in the FIAN stellarator are reviewed. The circuit of the microwave interferometer with electronic phase inverter creating traveling waves in the region $\lambda = 3$ cm is described. The resonance methods for the measurement of the plasma were examined. These use as a measurement resonator the metallic chamber of the

stellarator with excitation of basic (λ = 10 cm) and fast (λ = 8 mm) types of oscillations. The range of density measurement is from $n = 10^8$ to 10^{11} cm^{-3}. The Fabry–Perot microwave resonator in the region λ = 4 mm, constructed for density measurement of 10^9 to 10^{13} cm^{-3}, is described. The question of the effect of the magnetic field of the stellarator on the density measurement by resonator methods is examined. (tr-auth)

6648 MEASUREMENT OF THE POTENTIAL DISTRIBUTION NEAR AN ELECTRON BEAM USING A THERMIONIC PROBE. Bakhrakh, L.E.; Didusenko, A.V.; Medoks, V.G.; Rabinovich, E.M. (N. G., Chernyshevskii Saratov State University). Sov. Phys.-Tech. Phys. 17: No. 12, 2031-2033 (June 1973).

The results of an experimental investigation, obtained by means of an emission probe, of the radial potential distribution near a magnetically focused beam moving along the axis of a metal channel, are presented. (auth)

6649 LOCAL MEASUREMENT OF PLASMA PARAMETERS BY A SUPERHIGH FREQUENCY INTERFEROMETER WITH A PORTABLE EMITTER. Skibenko, A. I.; Belan, N. V.; Pimkin, V. A. pp 173-182 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

For study of an inhomogeneous plasma with random spatial distribution, a microwave method was proposed. The method was based on the measurement of the phase displacement and wave attenuation in the variable space between the emitting and receiving installations. The measurement results of the spatial density distribution and the effective collision frequency in the moving plasma jet are reported. The measurements were made with use of the wave λ = 4 mm, and the space was measured by the shift of the emitter located in the plasma. A comparison of the local value of the density with the results of the determination of N(r) by refraction was made. (tr-auth)

6650 SOME METHODS FOR DIAGNOSTICS OF DENSE PLASMAS FROM PULSED DISCHARGES AT HIGH PRESSURE. Mitin, R. V.; Petrenko, V. I.; Kantsedal, V. P.; Zvyagintsev, A. V. pp 182-195 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Some diagnostic methods that can be used for study of dense plasma at temperatures of tens of thousands degrees Kelvin and density of 10^{19} to 10^{21} cm^{-3}, when the plasma is opaque for visible light, are described. Possibilities of using the method of magnetic probes translucent to x radiation and some other methods for the diagnostics of plasma of high-current pulse discharges at high pressure are discussed. (tr-auth)

6651 INVESTIGATION OF TURBULENT PLASMA IN REFLECTING DISCHARGE BY MEANS OF DOUBLE ELECTRIC PROBES. Vasil'ev, M. P.; Pavlichenko, O. S.; Tereshchenko, F. F. pp 195-203 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Development of a method for investigation of plasma fluctuations by means of a double electric probe in a magnetic field, when the volt–ampere characteristics of the probe are not described by the Johnson–Malter formula, is discussed. An empirical formula, satisfactorily describing the characteristics of the double probe in a magnetic field, and used to establish the relation of the current fluctuation on the double probe with the fluctuation of the plasma parameters, was derived. Results of the measurement of the fluctuation levels and the fluctuation current of the particles in the reflecting discharge are reported. (tr-auth)

6652 MEASUREMENT OF THE TURBULENT HIGH-FREQUENCY FIELD IN HIGH-CURRENT LINEAR GAS DISCHARGES BY THE INTENSITY OF FORBIDDEN LINES OF He I. Zelenin, G. V.; Kutsyn, A. A.; Maznichenko, M. E.; Pavlichenko, O. S.; Suprunenko, V. A. pp 203-208 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

In the turbulent plasma of high-current linear gaseous discharge (z-pinch), satellites near three forbidden lines of He I, predicted by the Baranger and Mozer theory, were detected and investigated. Tentative measurements of the position and intensity of the satellites made it possible to measure the electron density, frequency, and level of the plasma oscillations in time. Observations of the satellites seem to suggest a new contactless method for the study of turbulent plasma. (tr-auth)

6653 PROBLEM ON INCREASE OF EFFICIENCY IN USE OF LASERS IN EXPERIMENTS ON LIGHT SCATTERING IN PLASMA. Kotsubanov, V. D.; Leikin, A. Ya.; Pavlichenko, O. S. pp 208-212 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The possibility of using lasers with closed resonators in experiments on the Thomson scattering of light in stationary and quasi-stationary plasma was examined. An optical scheme of the experiment was proposed, and its model is described. (tr-auth)

Kinetics (General)

Refer also to abstracts 6613, 7051, and 7052.

6654 (NP-19860) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-FIFTH SIX-MONTHLY PROGRESS REPORT, 1st JANUARY-30th JUNE 1973. (Sydney Univ. (Australia). School of Physics). [nd]. 12p. (PR-25). Dep. NTIS (U. S. Sales Only) $3.00.

Summaries are given of experimental progress in plasma sources, hydromagnetic shock waves, rotating plasmas, microwaves, and far infrared work. (AT)

6655 "SEMICLASSICAL" BREMSSTRAHLUNG CALCULATIONS. Oppenheim, A. (Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964). Phys. Rev., A; 8: No. 2, 717-723(Aug 1973).

The quantum calculation leading to the bremsstrahlung power density which varies as the square root of the plasma temperature T is reasonably successful in predicting the x-ray production when electrons bombard metal targets. It is expected to be useful in other cases where interaction times are small, such as when electrons stream through neutral gases, or when plasmas are sufficiently dense so that the number of particles in a Debye sphere is small. In the case of rarefied plasmas, for which there is no corresponding quantum treatment, common practice is to begin with classical orbit theory and either cut off in impact parameter or in frequency in order to obtain a power density which also varies as $T^{1/2}$. We show that all such "semiclassical" treatments for rarefied plasmas are either physically or mathematically inconsistent; that the usual cutoffs in impact parameter do not lead to the expected $T^{1/2}$ power density in the temperature range from 0.01 eV to 1 keV; and that the spectrum of the power density obtained by cutting off at the de Broglie wavelength contains frequencies in excess of the usual one-photon emission limit. (auth)

6656 FLOW IONIZATION OF HYDROGEN BY MIRROR REACTOR EXHAUST. Miller, R. L.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 17: 44-45(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6657 FIZIKA PLAZMY I PROBLEMY UPRAVLYAEMOGO TERMOYADERNOGO SINTEZA. Vypusk 4. (Plasma Physics and Problems of Controlled Thermonuclear Synthesis. Number 4). Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). 243p.

Separate abstracts were prepared for the 27 included papers. (MOW)

For abstracts of individual papers see: 5092, 6637, 6638, 6649–6653, 6658–6664, 6668–6674, 6680–6683, and 6713.

6658 INVESTIGATION OF THE PENNING DISCHARGE AT LOW PRESSURE. Safronov, B. G.; Konovalov, V. G. pp 27-37 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of a study of the diagmagnetism of the plasma of a Penning discharge from the pressure, magnetic field, and applied voltage are reported. A strong dependence of the diagmagnetism and circulating current on the applied voltage was found. The ratio of the circulating current to the discharge current represents the decreasing characteristics with increased pressure. The energy lifetime of the plasma (approximately 300 μsec) at a pressure of 1×10^{-4} torr was determined, agreeing with the time of the ionization collisions. From the form of sputtering on the cathode, an evaluation was made of the transverse energy component of the ions. The maximum value of this energy is equal to the applied voltage. (tr-auth)

6659 ELECTRICAL POLARIZATION OF PLASMA FLOW IN AN AXIALLY SYMMETRIC MAGNETIC FIELD. Azovskii, Yu. S.; Guzhovskii, I. T.; Khizhnyak, N. A. pp 49-59 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The axial and radial electric polarization field in a plasma flow

was studied, both in the homogeneous and the inhomogeneous range of the magnetic field. A good qualitative agreement of the experimental results with theory was observed. Experimentally, it was found that, at the front of the increasing magnetic field, the inducing current and the radiation polarization field were concentrated on the periphery of the plasma flow and the central part of the flow remains undisturbed and quasi-neutral. In the quasi-homogeneous region of the magnetic field the polarization spans the entire cross section of the flow. In relation to the penetration of the flow in the increasing magnetic field, the radial electric field increases monotonously with the increase of the vacuum field and reaches saturation in the quasi-homogeneous magnetic field, whereas the axial electric field has a maximum in the region of the inhomogeneous magnetic field and is missing in the homogeneous field. In the region of the inhomogeneous field, the axial polarization field is missing at the axis of the flow and increases with increased radius. (tr-auth)

6660 INVESTIGATION OF DYNAMICS OF PLASMA FLOW IN THE FIELD OF A PULSED MAGNETIC BARRIER. Zavada, P. I.; Kalmyukov, A. A.; Tereshin, V. I.; Chebotarev, V. V. pp 77-97 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The character of the processes occurring in a plasma flow moving in a field of pulse magnetic barrier was studied from the viewpoint of the possibility of the utilization of such a system for the formation of short plasma bunches from a three-dimensional nonhomogeneous flow. The study was made with both experimental and numerical methods. The calculations were made within the framework of a generalized model of a flexible current loop. The numerical integration of the system of equations was done for a wide collection of initial parameters, close to experimental parameters, on a digital computer. A detailed picture of the distribution of the azimuthal and Hall currents and the particle density in the plasma flow passing through the magnetic barrier were obtained experimentally. The experiments showed that, during motion of the plasma flow in the barrier field with high intensity (up to 20 kOe), two basic processes occur. On the one hand, slowing down and subsequent reflection of the peripheral plasma layer were observed; on the other hand, not less than 25 to 30% of the current proceeds through the barrier. During this the plasma flow rapidly disperses, following behind the strong lines of the vacuum magnetic field so that, on large distances behind the magnetic barrier, the passing plasma forms an insignificant part of the original flow. The rapid diffusion of the current and field into the plasma and their attenuation observed in the experiment is explained by the abnormally low conductivity of the plasma. In its turn, the abnormal conductivity is associated with excitation in the plasma of ion-acoustic oscillations. The possibility of the origin of current instabilities under the experimental conditions was discussed. A comparison was made of the calculated and experimental data obtained under the same conditions, with consideration of the abnormal conductivity of the plasma. The comparison showed good agreement of these results for a given range of the magnetic field (no nearer the radius up to the center of the coil), where the proposed model can again be correct. The results obtained give direct recommendations for the construction of a forming system and can be of interest during the examination of other questions of plasma dynamics. (tr-auth)

6661 SHAPING OF PLASMA BUNCHES MOVING IN A LONGITUDINAL MAGNETIC FIELD. Voitsenya, V. S.; Onishchenko, I. N.; Sappa, N. N. pp 98-105 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The possibility of splitting off the slow part of the plasma bunch moving along the axis of the homogeneous magnetic field was studied. In the process, after passage of the fast plasma, the regions of the splitting off engaged the pulse transverse field, thus deflecting the strong lines of the longitudinal magnetic field. The slow plasma, moving along the strong lines of the bent field, drifts from the pre-axial region and is lost in the diaphragm and walls of the chamber. The efficiency of such a method was shown experimentally by forming plasma bunches with density on $n \cong 10^{13}$ cm^{-3}. (tr-auth)

6662 MOVEMENT OF PLASMA IN CURVED MAGNETIC FIELDS OF CONSTANT AND ALTERNATING CURVATURE. Voitsenya, V. S.; Onishchenko, I. N.; Sappa, N. N.; Safronov, B. G. pp 114-122 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The movement of hydrogen plasma along a toroidal magnetic field was investigated. Results obtained in other studies were considered, allowing for the fact that the polarized electric field of the leading part of the plasma bunch can be short-circuited into the following very slow plasma. A comparative study of the movement of the plasma ($n \sim 10^{13}$ cm^{-3}) along the toroidal magnetic field and a field, the strong lines of which have alternating curvature showed that, in the second case, the configuration has much better properties for the transport of plasma. (tr-auth)

6663 INVESTIGATION OF BREMSSTRAHLUNG OF PLASMA FROM COAXIAL SOURCES. Dushin, L. A.; Privezentsev, V. I.; Tolstolutskii, A. G. pp 154-159 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of a study of the continuum of the bremsstrahlung of plasma from coaxial sources in the visible spectral range by the method of local selection of the luminescence are reported. According to the intensity of the radiation, the spatial distribution of the plasma density was determined. The electron temperature was measured independently of the relative intensity of the bremsstrahlung in the soft x-ray region by the method of absorbing filters. (tr-auth)

6664 USE OF CYBERNETICS IN STUDIES ON PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR SYNTHESIS. Zhdanov, A. I.; Kitaevskii, L. Kh.; Repalov, N. S.; Suprunenko, V. A.; Tolok, V. T.; Khizhnyak, N. A. pp 215-224 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of contemporary methods and means of calculating techniques in organizations planning and carrying out thermonuclear studies, both domestic and foreign, are briefly reviewed. On the basis of the results, obtained by cybernetics, mathematical simulation, information theory, etc., with consideration of the current studies and experimental needs, recommendations are made on the automation of processing experimental data. The future use of mathematical-simulation methods for the solution of a series of problems on plasma physics, particularly for the solution of nonlinear problems in hydrodynamic and kinetic approximations, is discussed. (tr-auth)

Kinetics (Experimental)

6665 MICROWAVE AFTERGLOW IN AN ARGON–HYDROGEN MIXTURE. Abramova, T.S.; Egorov, V.S.; Zatserkovnyuk, N.M.; Pastor, A.A.; Starik, A.M. (Leningrad Collective for Electronic Instrument Manufacture). Sov. Phys.–Tech. Phys. 17: No. 12, 1933-1937 (June 1973).

The mechanism responsible for increasing the plasma decay rate when hydrogen is added to argon is investigated. Microwave and optical methods and a mass spectrometer are used. The attenuation introduced by the microwave plasma is measured at various times following the microwave pulse and the critical microwave field strength is determined, both as functions of the partial H_2 pressure. The intensity of various argon and hydrogen lines in the 400–900 nm region are measured at the same pressures as in the microwave measurements. A mass spectrometer is used to analyze the dc pulsed discharge. It is shown that plasma decay in argon involves recombination, the rate being affected by recombination of Ar_2^+ ions, and that the number of metastables is relatively large after the pulse terminates. The acceleration of the decay when hydrogen is added to the argon can be explained qualitatively by the resultant formation of ion–molecular reactions of ArH^+ and H_3^+ ions that give rise to a greater recombination factor than in pure Ar. Moreover, hydrogen, a light gas, facilitates rapid cooling of the electron gas in the afterglow and also reduces the number of metastables. (auth)

6666 EXPERIMENTAL OBSERVATIONS OF THE THERMAL EXPANSION OF A PLASMA. Goldenbaum, G. C.; Gerber, K. A. (Naval Research Lab., Washington, DC). Phys. Fluids; 16: No. 8, 1289-1297(Aug 1973).

A dense argon plasma ($n_e = 4 \times 10^{15}$ cm^{-3}, KT = 4 eV) is created and allowed to expand either into a vacuum or into a low density, partially ionized plasma. Expansion into a vacuum is shown to be dominated by electric-field effects which accelerate ions to much higher energies ($E \leq 180$ eV) than the original thermal energy. Expansion into a low density ($n_e = 1 \times 10^{13}$ cm^{-3}) 10% ionized plasma of the same species was dominated by resonant charge exchange giving the appearance of momentum transfer. Expansion into a hydrogen plasma shows essentially complete momentum transfer as in a blast wave. Expansion of a hydrogen plasma into an ambient argon plasma shows spatially separated regions in which the hydrogen appears to collisionally snowplow the argon plasma. (auth)

6667 PROBABILITY DISTRIBUTION OF ELECTRIC FIELDS IN THERMAL AND NONTHERMAL PLASMAS. Klein, H.H. (Naval Research Laboratory, Washington, D. C. 20390); Krall, N.A.

Phys. Rev. A 8: No. 2, 881-886 (Aug 1973).

The probability distribution of electric fields, P(E), in stable and unstable plasmas is investigated by numerical simulation techniques. The usefulness of this approach is demonstrated by comparing the present results with both new and previously published analytic calculations. The results have implications for experiments which use spectral line shapes [governed by P(E)] as a diagnostic tool to determine the plasma density and temperature. (auth)

6668 ELECTRIC CONDUCTIVITY OF PLASMA DURING COLLECTIVE INTERACTIONS IN HIGH-CURRENT GAS DISCHARGE. Manzyuk, N. A.; Sizonenko, V. L.; Stepanov, K. N.; Suprunenko, V. A.; Sukhomlin, E. A.; Ternopol, A. M. pp 15-20 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Experiments on the investigation of the conductivity of dense plasma in a fairly strong electric field were analyzed. The results obtained are interpreted by the theory of anomalous resistance and heating of the plasma in the presence of ion-acoustic oscillations. (tr-auth)

6669 MAGNETIC FIELD EFFECTS ON THE PLASMA OF AN ELECTRODELESS DISCHARGE. Mitin, R. V.; Pryadkin, K. K.; Zvyagintsev, A. V. pp 37-46 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of an experimental investigation of the effect of rotation of the plasma of an electrodeless high-frequency discharge at high pressure with an external constant magnetic field are reported. The character of the dependence of the rotation frequency of the discharge on the kind of gas (Ne, Ar, Kr, and Xe), the strength of the magnetic field, and the pressure in the range from 0.5 to 2 atm. was established. The theory of electrophoresis in the gas-discharge plasma is proposed for explanation of the cause of the rotation. (tr-auth)

6670 EXPERIMENTAL STUDY OF INTERACTION OF PLASMA FLOW WITH A THREE-DIMENSIONAL PERIODIC MAGNETIC FIELD. Azovskii, Yu. A.; Guzhovskii, I. T. pp 59-67 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

By means of small magnetic and electric probes, changes in the magnetic field of the inducing current, the particle density, the electron temperature, and the radius of the plasma flow during its movement in a three-dimensional periodic magnetic field were studied. Experimentally, it was found that, in weak magnetic fields ($B_{I\,max} \leq 50$ G) when the radial compression is insignificant, "capture" and "transfer" fields of the plasma flow were observed from stage to stage. In very strong magnetic fields, both longitudinal and radial strong deformation of the flow occurred, accompanied by a decrease of the density, azimuthal induction current, and flow radius. The decrease of the azimuthal current, the particle density, and the radius of the plasma flow was caused by the magnetization of the plasma flow and its reflection of the peripheral region of strong magnetic field and by the drift of the magnetized and reflected plasma in the magnetic slit of the periodic field. The measurement of the temporary constant decrease of the density τ indicated that the transporting properties of the periodic and homogeneous field is approximately the same at small intensity of these fields. With increase of the external periodic field the temporary constant τ monotonously increases. (tr-auth)

6671 EXPERIMENTAL INVESTIGATION OF THE POLOIDAL CURRENT IN PLASMA FLOW IN AN INHOMOGENEOUS AXIALLY SYMMETRIC MAGNETIC FIELD. Azovskii, Yu. S.; Guzhovskii, I. T.; Khizhnyak, N. A. pp 67-77 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The axial component of the poloidal Hall current in the extended flow in an inhomogeneous axially symmetric magnetic field was investigated experimentally. It was found that in the plasma flow, interacting with the inhomogeneous axial field of the short coil and solenoid, two poloidal current loops with opposed direction of the axial current I_z in them were observed. Qualitatively, the experimentally obtained picture of the behavior of these currents in small magnetic fields ($B_{z\,max} \leq 0.2$ kG) agrees with the theoretical dependences for the stationary weakly interacting plasma flow with homogeneous distribution of the electron pressure in the flow. In strong magnetic fields, when substantial deformation of the plasma flow occurs, the experimentally observed distribution of the current I_z becomes substantially different from the theoretical distribution. In the magnetic field interval from 0.1 to 2 kG, the ratio of the axial current to the induction azimuthal current $I_{\phi max}/I_{\phi max} = 0.7$. The experimentally obtained radial distribution of the current in a narrow chamber and also the control measurements in a wide vacuum chamber indicate that the poloidal current proceeds within the plasma flow and that the boundary conductivity is unessential. (tr-auth)

6672 INTERACTIONS OF MOVING PLASMA WITH INHOMOGENEOUS MAGNETIC FIELDS. Voitsenya, V. S.; Onishchenko, I. N.; Sappa, N. N.; Safronov, B. G.; Trubchaninov, S. A. pp 105-113 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Movement of plasma bunches in two configurations of the magnetic field was studied: in the straight stellarator and in the magnetic field formed by the combination of an axial-symmetric field and a field of straight bars with alternating current. It was found that the plasma with density $\sim 10^{13}$ cm^{-3} moves along the strong lines, owing to the fact that the straight stellerator field as a waveguide is more efficient than the combination of the axially symmetric and multipole fields. Moreover, from results obtained by means of the double probes, it follows that the stellarator field decreases the inhomogeneity of the electric potential, which was observed during the movement of the fast plasma bunch ($v \sim 4.5 \times 10^7$ cm/sec) in the axially symmetric magnetic field. (tr-auth)

6673 INVESTIGATION OF DIAMAGNETISM OF PLASMA CREATED BY A COAXIAL GUN IN A LONGITUDINAL MAGNETIC FIELD. Zolototrubov, I. M.; Novikov, Yu. M. pp 147-150 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The plasma created by a coaxial gun located in a longitudinal magnetic field was studied. The magnetic field was created by the discharge of a condenser battery in the long solenoid. The construction of a probe permitting the elimination of signals formed by the changing-with-time magnetic field and the determination of the size of the transverse energy of the plasma in units of bunch length are described. The measurements showed that the increase of the intensity of the field after splitting off of slow component of the plasma does not change the linear density of the transverse energy in the fast bunches. (tr-auth)

6674 EFFECT OF THE QUANTITY OF NEUTRAL GAS ON THE FREQUENCY AND ENERGY SPECTRUM OF PLASMA BUNCHES IN A COAXIAL GUN. Skoblik, I. P.; Zolototrubov, I. M. pp 151-154 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

By trial and error of the original gas conditions, the operating regime of a coaxial gun without substantial erosion of the electrodes was found. The bunches generated have a high degree of purity. By increasing the current through the gun to 430 kA in this regime, the mean energy of the particles in the bunch was about 6 keV. (tr-auth)

Kinetics (Theoretical)

Refer also to abstract 6626.

6675 (NP-19862) MHD-EQUILIBRIUM OF A BELT-SHAPED PLASMA IN A TRKAL FIELD. Rijnhuizen Report 73-78. Hoekzema, J. A.; Schuurman, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Jul 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The MHD-equilibrium of a cylindrical plasma sheet of finite thickness surrounded by a Trkal magnetic field and in between two coaxial metallic walls is investigated. The plasma has a sharp boundary and carries a surface current only (plasma pressure is constant). Inside the plasma there is a trapped toroidal magnetic field. By applying a one-dimensional model the effect of top and bottom ends of a finite structure is neglected. However, the correspondence between magnetic surfaces on both sides of the plasma sheet is retained. The equilibrium equation is an expression relating the geometrical parameters, β of the plasma, the Trkal parameter α and a quantity k containing the safety factor q and the ellipticity of the device. For certain values of these parameters it turns out to be possible to approximate a configuration where the magnetic field lines have a constant pitch length. A number of numerical examples show how the displacement of the central plasma column depends on the various parameters. The equilibrium characteristics are improved by currents in the region outside the main plasma sheet. If the ratio between the height and the average major radius of the device is somewhat larger than the safety factor q, the equilibrium displacement is tolerable even for high values of β and there

seems to be no need to add an external magnetic field to shift the central plasma inward. (auth)

6676 (NP-19863) IDEAL MHD-EQUILIBRIUM OF A TOROIDAL FORCE-FREE PLASMA IN A TRKAL FIELD UP TO THIRD ORDER IN THE INVERSE ASPECT RATIO. Rijnhuizen Report 73-79. Schuurman, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Jul 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The ideal MHD-equilibrium configuration of a plasma ring (large radius R, small radius b) embedded in a Trkal magnetic field ($\vec{j} = \alpha\vec{B}$) is considered. The convergence of a series expansion of the magnetic flux in the inverse aspect ratio up to third order is investigated. For small α, the first-order correction is O (α^2b^3/R), all other orders being b/R times the next lower one. As expected, the second-order effect on the toroidal shift of the magnetic axis vanishes. (auth)

6677 INFLUENCE OF ION-RESONANCE BROADENING ON THE ANOMALOUS HEATING AND MOMENTUM TRANSFER IN A CURRENT-CARRYING PLASMA. Caponi, M.Z.; Davidson, R.C. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 31: No. 2, 86-89 (9 July 1973).

The anomalous heating and momentum transfer in a current-carrying plasma are calculated including the effects of ion resonance broadening on the nonlinear development of the ion acoustic instability. In the constant-current regime, the anomalous resistivity is found to be of order $(T_i/T_e)^{1/2}\omega_{pe}^{-1}$, which compares favorably with the measured resistivity in several experiments. (auth)

6678 PARALLEL AC COLLISIONAL CONDUCTIVITY OF A PLASMA IN A STRONG MAGNETIC FIELD. Scannapieco, A. J. Hanover, NH; Dartmouth Coll. (1973). 114p. University Microfilms Order No. 73-27,570.

Thesis (Ph.D.).

A calculation of the collisional component of the parallel ac electrical conductivity of a plasma in a strong magnetic field is presented. One understands strong magnetic field in the sense that in a two-body collision the Larmor radii of the colliding particles is comparable to or smaller than the distance over which the collision is effectively taking place (i.e., the Debye distance). To this end a kinetic equation first derived by N. Rostoker is used which takes into account the effect of the magnetic field during the Coulomb collision process. The Rostoker equation is restricted in that only the component of the ac collisional conductivity along the magnetic field can be calculated. The parallel component of the conductivity is obtained and the change in the effective Coulomb logarithm due to the magnetic field is displayed as a function of the ratio ($R = k_D^2/\Omega^2\beta$) where k_D is the Debye wavevector, Ω the electron cyclotron frequency, and β the inverse of the square of the electron thermal velocity. A computer code is displayed which calculates exactly the effective Coulomb logarithm. Terms of order unity compared with the Coulomb log (i.e., subdominant terms) are not retained. (Diss. Abstr. Int., B)

6679 SNOWPLOW MODEL FOR THE DYNAMICS OF EXPANDING PLASMAS. Albritton, J. R. New Haven; Yale Univ. (1973). 201p. University Microfilms Order No. 73-24,930.

Thesis (Ph.D.).

The work reported is an analysis of the retardation from free expansion of the plasma/field interface during an early phase of the explosion of perfectly conducting, field-free, collisionless plasma into a vacuum magnetic field. In this phase, the dynamics of the system can be described by a "multi-bounce model" in which impulse forces due to specular reflection of the expanding plasma elements at the interface are balanced against external backpressure. Systems studied are those wherein a thin, dense interface layer is formed, certain details of which are not important in the dynamics of its motion. In this case the interface layer can be approximated by a surface of finite mass per unit area moving under the influence of the external field and a "snowplow model" flow into it from the expanding plasma. (MOW)

6680 PROBLEM OF THE MOVEMENT OF PLASMA ACROSS AN INHOMOGENEOUS MAGNETIC FIELD. Voloshko, A. Yu.; Silenok-Bel'skii, G. A.; Solodovchenko, S. I. pp 122-126 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

A simplified analysis was made of the effect of the dispersion of particles according to velocity on the movement of the plasma across an inhomogeneous magnetic field. It was established that the movement of the real plasma across the inhomogeneous magnetic field is accompanied by the exchange of energy between the particles and other phenomena. (tr-auth)

6681 INDUCTION CURRENTS IN STATIONARY PLASMA FLOWS IN AN AXIALLY SYMMETRIC MAGNETIC FIELD. Cherkasova, K. P.; Guzhovskii, I. T.; Azovskii, Yu. S. pp 127-134 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The theoretical calculation of the distribution of the poloidal Hall current, the space charge, the potential, and electric field in the plasma flow, interacting with the axial magnetic field of the solenoid, is considered in the magnetohydrodynamic approximation. The flow was assumed stationary and cylindrical with homogeneous distribution of the parameters along the cross section and was directed along the axis of the external magnetic field; the magnetic field inside the flow was assumed equal to the external one. A comparison is made of the results for solenoids and short coils. (tr-auth)

6682 STRUCTURE OF THE CURRENT IN A STATIONARY PLASMA JET IN PRESENCE OF THE HALL EFFECT. Cherkasova, K. P. pp 135-144 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The structure of the current, induced in the plasma jet, moving in an axially symmetric magnetic field was studied. The movement in the three-dimensional periodic alternating magnetic field, producing a system of coaxial coils with counter current in the adjacent coils, was examined. Much experimental work has been devoted by others to the study of these movements; similar problems have been studied theoretically, earlier, by means of the generalized model of the flexible current loop. However, this model assumes induction in the plasma of only azimuthal current and excludes the influence of the Hall effect. In the present study the problem is solved in the magnetohydrodynamic approximation, with consideration of the Hall component in the generalized Ohm law. The magnetic Reynolds number and the interaction parameter are considered negligibly small. The solution for the electric field and the vector of current density is constructed in the expansion form by steps of the Hall parameter. The distributions of the potential, the electric field, and the first-order current, according to the Hall parameter, are found. The structure of the closed circuit loop formed was studied. (tr-auth)

6683 PROBLEMS ON USE OF ANALOG-DIGITAL COMPLEXES FOR STUDY OF NONLINEAR PHENOMENA IN PLASMA. Zhdanov, A. I.; Klimko, N. P.; Dem'yanov, V. G.; Khizhnyak, N. A.; Repalov, N. S. pp 225-228 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

The possibility of using small analog-digital complexes based on the MN-7 analog computer and the digital UMSHN "Dnepr" computer for solution of equations in partial derivatives describing processes in plasma was investigated. A description is given of the straight-line method used for the solution, and brief conclusions are presented. (tr-auth)

Production

Refer also to abstract 6636.

6684 (UCID-16318) TALK TO BE PRESENTED AT GORDON CONFERENCE, TILTON, N. H., AUGUST 22, 1973, GARCHING LAB., GERMANY, LEMIEL LAB., FRANCE, AND CULHAM LAB., ENGLAND, SEPTEMBER 1973. Bodner, S. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1973. Contract W-7405-Eng-48. 36p. (CONF-730840-1). Dep. NTIS $4.00.

From Gordon Conference; Tilton, New Hampshire, USA (22 Aug 1973).

A brief discussion of magnetic field generation in laser–pellet interactions is given. Proposed target experiments to study these interactions are described in detail. Some data from typical laser–pellet interactions are theoretically derived. The data are given for various experimental parameters. (MOW)

6685 NEUTRON EMISSION FROM LASER-PRODUCED PLASMAS. McCall, G. H.; Young, F.; Ehler, A. W.; Kephart, J. F.; Godwin, R. P. (Los Alamos Scientific Lab., NM). Phys. Rev. Lett.; 30: No. 22, 1116-1118(28 May 1973).

Neutron emission from laser-produced plasmas is shown, experimentally, to be adequately explained by electron heating and electrostatic ion acceleration. The absence of anomalous ion-heating mechanisms is not proved, but these mechanisms, if they exist, may be unimportant in reported experiments. It is concluded that no neutrons of thermonuclear origin are necessary to explain the results obtained thus far. (auth)

6686 VII INTERNATIONAL QUANTUM ELECTRONICS CONFERENCE, MONTREAL, CANADA, MAY 8–11, 1972. Digest of Technical Papers. New York; Institute of Electrical and Electronics Engineers, Inc. (1972). 114p. (CONF-720558-).

Summaries are presented for each of the 242 papers presented at the conference. The papers are listed according to the following sessions: (1) nonlinear optics and scattering, (2) dye lasers, (3) solid-state lasers, (4) uv and x-ray lasers, (5) integrated optics, (6) laser-produced plasmas, (7) laser optics and detectors, (8) spectroscopy, (9) tunable lasers and parametric processes, (10) chemical and gas lasers, (11) theory and self-focusing, (12) self-induced transparency and nonlinear optics, (13) Co_2 lasers, (14) short pulses and mode locking, (15) optical materials, and (16) cosmic, Co, and gas dynamic lasers. (MOW)

6687 OVERVIEW OF LASER-INDUCED FUSION. Bruckner, K. A. (KMS Fusion, Inc., Ann Arbor, MI). Trans. Amer. Nucl. Soc.; 17: 226(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6688 LASER BEAM INTERACTIONS IN GASES. Watson, K. M. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 17: 226(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6689 NUMERICAL SIMULATION OF THE HIGH-DENSITY APPROACH TO LASER FUSION. Zimmerman, G. B. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 17: 226-227(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6690 NUMERICAL SIMULATION OF LASER FUSION. Morse, R. L. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 227(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Stability

Refer also to abstract 6677.

6691 (CEA-CONF-2398) MEASUREMENTS OF THE LINEAR AND NONLINEAR STAGE OF THE BEAM-PLASMA INSTABILITY. Aymar, R.; Boehmer, H.; Koechlin, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd] 4p. (CONF-730705-14) Dep. NTIS (U. S. Sales Only) $3.00.

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

An electron beam is injected into the afterglow plasma of a pulsed P. I. G. discharge immersed in a uniform magnetic field of 2800 G. The plasma diameter is 5 cm, the length is variable from 150 to 230 cm. At the time the electron beam is pulsed, the average plasma density, measured with a microwave interferometer, is in the range 10^{10} to 2×10^{11} cm^{-3}; the electron temperature, obtained with a Langmuir probe, is 0.75 ± 0.25 eV. Therefore, the ratio of electron collision to plasma frequency is 10^{-3}, so that collisions can be neglected in the dispersion relation for the hydrodynamic beam–plasma instability. The radial electron density profile, also measured by a Langmuir probe, is used to calculate the plasma branch of the dispersion relation, for $\omega_{ce}/\omega_{pe} > 2.5 \gg 1$. The electron beam energy is 6.5 keV, with an initially narrow energy distribution ($\Delta E/E \sim 1\%$), its diameter is 0.8 cm, and the pulse duration is 15 μsec. The ratio of beam density to plasma electron density is $< 5 \times 10^{-3}$. (auth)

6692 EVOLUTION OF BERNSTEIN-GREENE-KRUSKAL-LIKE ION MODES WITH TRAPPED ELECTRONS. Wong, A.Y.; Quon, B.H.; Ripin, B.H. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 30: No. 26, 1299-1302 (25 June 1973).

The growth of an ion acoustic instability caused by a slow electron drift is studied experimentally. A small-amplitude test wave in this unstable system develops into a large-amplitude steady state which is found to be a Bernstein-Greene-Kruskal-like ion mode with trapped electrons. (auth)

6693 TRANSITION FROM ABSOLUTE TO CONVECTIVE INSTABILITY IN A BEAM–PLASMA SYSTEM. Boyd, D.; Carr, W.; Manickam, J.; Rosen, B.; Seidl, M. (Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Rev. Lett. 30: No. 26, 1296-1299 (25 June 1973).

The electrostatic instability in a magnetoplasma, $\omega > \omega_{ce}$, excited by a weak electron beam is found to be either convectively unstable (amplifying) or absolutely unstable (oscillating) depending upon effective plasma electron temperature and beam density. Measurements of the transition between the two types agree with calculations. (auth)

6694 STABILIZING EFFECT OF AN ELECTRON TEMPERATURE GRADIENT ON COLLISIONLESS DRIFT INSTABILITIES. Brossier, P.; Deschamps, P.; Gravier, R.; Pellat, R.; Renaud, C. (Association EURATOM–Commissariat à l'Energie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Controlée, Centre d'Etudes Nucléaires, 92 Fontenay–aux–Roses, France). Phys. Rev. Lett. 31: No. 2, 79-82 (9 July 1973).

The radial electron temperature profile of a hydrogen plasma column is controlled by electron–cyclotron resonance heating. With the use of this technique the stabilizing effect of the electron temperature gradient on collisionless drift instabilities is checked experimentally. (auth)

6695 OSCILLATIONS IN A SYNTHESIZED PLASMA JET. Yakovleva, M.N.; Mantrova, G.M.; Novskova, T.A. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 12, 1928-1932 (June 1973).

The oscillations in a synthesized argon plasma are investigated in the frequency range 0.2 to 150 MHz. The parameters of the synthesized plasma, the spatial distribution of the oscillation amplitude in the jet and outside it at various frequencies, and the noise in the ionization chamber are studied. The oscillations at high frequencies are due to the interaction between the electron stream and plasma in longitudinal modes; the low–frequency oscillations are a result of modulation of the ion beam by oscillations in the ionization chamber of the ion source. (auth)

6696 STABILITY OF A RELATIVISTIC BEAM IN A PLASMA. Grishin, V.K.; Kolomenskii, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Phys.–Tech. Phys. 17: No. 12, 2022-2024 (June 1973).

The stability of a relativistic beam with finite transverse dimensions in a plasma–like medium in a strong longitudinal magnetic field is analyzed. The electromagnetic oscillations in a beam propagating in a medium (the latter is described phenomenologically as a medium with certain dielectric properties) are investigated taking account of the self–magnetic field of the particles. In relativistic beams the self–magnetic field exerts a strong influence on the character of the self–particle density fluctuations. Consequently, in addition to the Buneman instability considered in detail in other papers, there is a Cerenkov instability if $\epsilon_\perp \beta^2 < 1$, where $\epsilon_\perp$ is the transverse component of the dielectric tensor of the plasma–like medium in a magnetic field and β is the ratio of the particle velocity to the velocity of light in vacuum. The analysis shows that Cerenkov instability appears at lower beam densities than the Buneman instability. (auth)

6697 TOROIDAL EFFECTS OF TEARING MODE INSTABILITIES IN TOKAMAKS. Flint, G. L. Jr. Austin, TX; Univ. of Texas (1973). 253p. University Microfilms Order No. 73-26,005.

Thesis (Ph. D.).

In order to investigate toroidal effects on tearing modes in tokamaks, stability criteria are derived by means of an expansion in the inverse aspect ratio. The stability criteria for nonresistive magnetohydrodynamic modes are modified to apply to the resistive tearing mode. Only cases in which the resistive layer falls between the plasma radius and that of a conducting wall can be treated by this method. For a pressureless system the well-known stability criterion for tearing modes is determined in second order. Here, it is shown that for a low pressure system, $\beta_\theta \sim 1$, the toroidal effects modify this criterion favorably in fourth order. Typically the improvement in stability is most significant when the resistive layer is close to the plasma radius. Some examples have been chosen so that comparisons can be made between the current work and that of others using different criteria and treating only the cases of constant current density or pressureless plasma. (Diss. Abstr. Int., B)

6698 LOW-FREQUENCY FLUTE INSTABILITIES OF A HOLLOW CATHODE ARC DISCHARGE: THEORY AND EXPERIMENT. Ilic, D. B.; Rognlien, T. D.; Self, S. A.; Crawford, F. W. (Stanford Univ., CA). Phys. Fluids; 16: No. 7, 1042-1053(Jul 1973).

The characteristics of two low-frequency electrostatic flute instabilities of a low-pressure hollow cathode arc discharge are reported. Mode I has azimuthal mode number $m = 1$, and occurs when the radial electric field is negative (directed inward) while mode II has $m = -1$ and occurs when the field is positive. The radial electric field is controlled by varying the potential of a secondary anode cylinder located close to the outer discharge radius. A linear perturbation analysis, based on the two-fluid

equations, is given for a low-β, collisionless, cylindrical plasma column, immersed in a uniform axial magnetic field, having a Gaussian density profile and an arbitrary radial electric field profile. Reasonable correlation between theory and experiment is demonstrated for both modes, by comparing the calculated and measured frequencies, mode numbers, and also the eigenfunctions of the density and potential fluctuations. The instabilities are basically centrifugal flute modes, driven by $E \times B$ drift in the presence of a density gradient and modified by the velocity shear due to nonuniform $E \times B$ rotation. (auth)

6699 FEEDBACK STABILIZATION TECHNIQUES FOR LOW-FREQUENCY INSTABILITIES IN THE HOLLOW-CATHODE ARC. Stufflebeam, J. H. Troy, NY; Rensselaer Polytechnic Inst. (1973). 115p. University Microfilms Order No. 73-27,234. Thesis (Ph.D.).

A theoretical analysis is developed to describe the physical mechanisms of the instability. Inclusion of a term representative of the feedback suppressor signal shows control of the initial growth rate of the oscillation. A nonlinear analysis predicts the observed variations of instability amplitude when the system is perturbed by the feedback system. The experimental investigation is carried out on a hollow-cathode arc discharge in argon. The low-β plasma produced is confined by a longitudinal, uniform magnetic field and has radial density and potential gradients which give rise to a low frequency instability. Suppression of this instability is accomplished by a new remote technique. The instability was detected by various methods including an optical sensor, magnetic pick-up coil, and a Langmuir probe. The first two techniques are remote elements while the latter is in contact with the plasma. The remote suppressor signal is a low frequency (≈5 MHz) carrier, modulated at the frequency of the instability (≈5 KHz). This suppressor signal is applied to a coil wound perpendicular to the discharge axis and outside the vacuum chamber. With all parameters optimized, the amplitude of the instability can be reduced to the level of the background noise. Upon suppression the density increases in the region of stabilization and decreases at the walls of the device. The behavior of the reduced amplitude of the instability with carrier frequency and power, modulation gain and phase is reported. Control of the radial plasma density and potential profiles is also shown. Documentation of the resonance phenomenon associated with the remote suppressor signal is included. Results from an earlier, localized, stabilization system, employing Langmuir probes as feedback elements, are included and compared with the new remote suppression system. (Diss. Abstr. Int., B)

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Refer also to abstracts 4963, 4964, 5424, 5443–5446, 5460, 5461, 5519–5521, 5549, 5550, 5586, 5587, and 7460.

6700 (CEA-CONF-2433) CHOICE OF THE TOKAMAK LINE, AND THE PHYSICAL PROBLEMS OF CONFINED TOROIDAL PLASMAS. Maschke, E. K. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd] 37p. (In French). (CONF-730574-5). Dep. NTIS (U. S. Sales Only) $4.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The tokamak device is compared to other lines of research in controlled fusion, and the arguments in favor of the choice of the Tokamak are discussed. The physical problems concerning toroidal plasmas are treated, in particular, the motion of charged particles, the transport coefficients due to collisions between particles, the instabilities of the plasma, and the anomalous transport by convection and turbulence. (FR)

6701 (CONF-730414-P2, pp VI.162-VI.179) METHOD FOR THE OPTIMIZATION OF FUSION REACTOR NEUTRONIC CHARACTERISTICS. Greenspan, E. (Princeton Univ., NJ). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A method for the optimization and analysis of fusion reactors nucleonic characteristics is described. The method can handle both nucleonic and nonnucleonic properties of the system either as the parameter to be extremized or as the restraint. The nucleonic characteristics are treated as bilinear functionals, and the optimization method is based on variational techniques. The control variables are material density distributions. Numerical examples, based on transport calculations, are given for four different types of optimization problems and for perturbation analysis. Special features of the method are discussed. (auth)

6702 (GULF-GA-12556) CHARACTERISTICS OF DOUBLET II DISCHARGES. Ohkawa, T.; Chu, M.; Fisher, R.; Hsieh, C. L.; Jensen, T. (Gulf General Atomic Co., San Diego, Calif. (USA)). 27 Feb 1973. Contract AT(04-3)-167. 18p. (CONF-730466-1). Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Munich, F. R. Germany (23 Apr 1973).

Experimental results obtained in the Doublet II device are discussed. Discharges with topologically different magnetic configurations are observed. Of these, the Doublet and the Droplet configurations have been subject to most study. Doublet discharges with up to 500-kA plasma current and a duration of 1 to 2 msec and Droplet discharges of typically 100 kA and a duration of 10 to 20 msec were obtained. The latter type of discharge appears similar to Tokamak discharges, except that the toroidal magnetic field strength is much smaller in the Doublet II device. (auth)

6703 (UCRL-74802(Rev.1)) SUPER-HIGH-DENSITY LASER FUSION CTR. Thiessen, A.; Zimmerman, G.; Weaver, T.; Emmett, J.; Nuckolls, J.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1973. 33p. (CONF-730705-25). Dep. NTIS $3.75.

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

A basic discussion of laser-induced fusion is presented. Implosion development and applications are described. Implosion and thermonuclear physics are discussed in some detail along with laser technology, laser fusion reactors, and fusion energy conversion. (MOW)

6704 (UCRL-75141) GEOMETRY AND HETEROGENEOUS EFFECTS ON THE NEUTRONIC PERFORMANCE OF A YIN YANG MIRROR REACTOR BLANKET. Lee, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1973. 12p. (CONF-731114-5). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Two-dimensional models and Monte Carlo neutron transport techniques were used to calculate the tritium breeding and energy generation in a mirror-reactor blanket. Results indicate that blanket performance should be quite insensitive to variations in overall geometry as long as there are no large neutron-leakage paths. Injection and leakage penetration can be accommodated as long as the first-wall penetration area subtends less than 25% of the first wall's spherical area. Heterogeneous and streaming effects in a tubular blanket can be important, but are negligible for closely packed arrays of tubes. The one-dimensional homogeneous spherical-shell model appears to be a useful tool for predicting performance of a tubular blanket conforming to the Yin–Yang mirror geometry. (auth)

6705 (WASH-1268) REPORT OF THE REVIEW PANEL ON THE PROPOSED STAGED THETA-PINCH EXPERIMENT. (USAEC Division of Controlled Thermonuclear Research, Washington, D. C.). 7 Jun 1973. 9p. Dep. NTIS $3.00.

Background information on proposed experiment is discussed along with the implosion heating experiment, staged theta-pinch experiment, Scyllac experiments, and other experiments. The panel recommends that the Los Alamos Scientific Laboratory be permitted to proceed with the staged theta pinch experiment. (MOW)

6706 (WASH-1277) SURVEY OF THE USAEC PROGRAM IN CONTROLLED THERMONUCLEAR RESEARCH. Second Edition. Robbins, L. W. (ed.). (USAEC Division of Controlled Thermonuclear Research, Washington, D. C.). 1973. 76p. GPO $0.75.

This booklet is intended to provide a general description of the fusion research program of the USAEC Division of Controlled Thermonuclear Research. Summaries of experimental and theoretical research currently in progress are given. (MOW)

6707 EFFECT OF THE GEOMETRIC ERROR OF THE MAGNETIC SYSTEM ON THE TOPOLOGY OF A STELLARATOR FIELD. Danilkin, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 26-49(1973). (In Russian).

A systematic discussion is given of the question of the effect of the disturbance of the geometric parameters of the magnetic system of stellarators on the topology of its field. The groups found were developed, and the possible geometric distortions are described. The necessary tolerances were evaluated. Specifically, it was found that, with the major resonance in the pre-axial region caused by the relative misalignment of the longitudinal and spiral

fields, the relative necessary inhomogeneity is of the order of 10^{-3}. (tr-auth)

6708 NEW DESIGN OF A DOUBLE-RING STELLARATOR. Danilkin, I. S.; Shpigel, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 50-64(1973). (In Russian).

A series of specifications for toroidal systems are formulated. A new design of a double-ring stellarator capable of meeting these specifications is proposed. The new design differs from previous ones by the high stability of the field configuration and has improved features, guaranteeing confinement of the plasma and the individual particles. The construction of the system guarantees easy admission to the working space and good vacuum conditions. It has a small mechanical load on the most complex technological elements. (tr-auth)

6709 STELLARATOR TOR-2. Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 65-72(1973). (In Russian).

The difference of the Tor-2 stellarator from other stellarators lies in the fact that the magnetic field is created not by a spiral winding but by a discrete coil of electrical profile. Theoretical premises, serving as the basis for the design of the installation, and the results of the preliminary studies were discussed. (tr-auth)

6710 STRUCTURE OF THE MAGNETIC FIELDS OF THE TOR-1 AND TOR-2 STELLARATORS. Andryukhina, E. D.; Ivancvskii, M. A.; Popov, S. N.; Popryadukhin, A. P.; Fedyanin, O. I.; Khol'nov, Yu. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 73-81(1973). (In Russian).

The structures of the magnetic surfaces in toroidal plasma traps with double spiral fields, the Tor-1 and Tor-2 stellarators, were studied by the electron beam method. The usual probe method and the highly effective dielectric-grid method were used for the beam recording. It was found that the structure of the surface is regular up to an angle of rotational transform i of the order of 5.5 π in all the areas of change of i, with the exception of the resonance values $i = \pi$, 2π, and 4π, for which a splitting of the surface with formation of a rosette structure was registered. The amplitude of the resonance disturbance measured through the width of the rosette is of the order of 10^{-4} from the amplitude of the basic field of the stellarator. (tr-auth)

6711 ENERGY BALANCE OF NUCLEAR FUSION REACTIONS (DT) IN THE BEAM-PLASMA TARGET SYSTEM. Demirkhanov, R. A.; Kursanov, Yu. V.; Skripal, L. P. At. Energ. (USSR); 34: No. 6, 490-491(Jun 1973). (In Russian).

In connection with the possible production of beams of high-energy ions and neutral atoms at a current in the tens of amperes, and plans of using these beams for plasma heating, interest has arisen in the energy balance of (d,t) reactions taking place during acceleration of deuterons with a tritium plasma target. The conditions of a positive energy balance have been investigated in the case of a pure tritium target. This study takes into account the effect of accumulating deuterons in the tritium target. The condition for a positive energy balance of the steady-state plasma–beam system is presented. The target temperature is shown to have a minimum at ~200 keV. The accumulation of deuterons in the tritium target will increase the plasma temperature T_e and the tritium concentration n. The best approximation is that 10% of the deuterons should be allowed to accumulate in the tritium target. With a tritium concentration $n = 10^{14}$ cm^{-3}, fraction of deuterium in the tritium target $\alpha = 0.1$, and T_e = min, the beam current is about 8.3×10^{-6} amps/cm^3, or 8.3 amps for a volume of 10^6 cm^3. This current is within the capabilities of present technology. (SJR)

6712 THEORY OF ELECTRON DISTRIBUTIONS FOR SMALL FIELD CANCELLATION IN THE QUIESCENT E LAYER OF THE ASTRON. Humphries, S. Jr. (Univ. of California, Livermore). Phys. Fluids; 16: No. 7, 1003-1010(Jul 1973).

A theory appropriate to the description of the stable astron E layer in experiments up to the present time is developed. When field cancellation is small and it can be assumed that the E layer is perturbed by collisions with a uniform background neutral gas, it is shown that the axial and radial distributions are described by simple cylindrical diffusion equations. The model predicts loss rates of the E layer as well as self-consistent radial and axial density profiles. (auth)

6713 POSSIBILITY OF CREATION OF A WIDE-APERTURE INJECTOR OF FAST NEUTRAL ATOMS. Borisenko, A. G.; Bredikhin, M. Yu.; Glasov, B. V.; Drui, O. S.; Il'chenko, A. M.; Nikolaev, G. T.; Skibenko, E. I.; Yuferov, V. B. pp 159-169 of Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza. Vypusk 4. Tolok, V. T. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Results of the investigation of two wide-aperture ion sources, a circular cold-discharge source and a sector duoplasmatron with flat electrodes, are described and reported. In the circular source in the pulse regime (duration of the pulse is 1 msec, working voltage is 1 kV, and discharge current is 10 A) the total current of argon ions on the collector equals 1.7 A. In the sector source in the stationary regime, argon ions of 15 kV and 70 mA were obtained. Studies were made of wide-aperture gas targets for ion overcharge in circular and sector ion sources. Gaseous targets created by means of continuous circular nozzles and targets produced by superposition of conical nozzles were studied. Ar, CO_2, and Mg vapor were tested as jet material. In all cases the thickness of the target was 10^{15} cm^{-2}. (tr-auth)

6714 NEUTRONIC–PHOTONIC COMPARISON OF VANADIUM- AND NIOBIUM-CONTAINING FUSION REACTOR BLANKETS. Parish, T. A.; McArdle, B. J.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 17: 31-32(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6715 IMPORTANT CONSIDERATIONS IN THE DESIGN OF A SHIELD FOR A CTR MAGNET. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 32-33(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6716 CONSISTENCY OF NUCLEAR DATA AND PROCESSING CODES FOR CALCULATION OF NUCLEAR HEATING IN FUSION REACTORS. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 33-35 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6717 BLANKET NEUTRONIC STUDIES FOR A FUSION POWER REACTOR. Price, W. G. Jr. (Princeton Univ., NJ). Trans. Amer. Nucl. Soc.; 17: 35(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6718 TRITIUM BREEDING AND NUCLEAR HEATING IN A REFERENCE THETA-PINCH REACTOR (RTPR). Dudziak, D. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 36-37(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6719 BULK SHIELDING STUDIES FOR A REFERENCE THETA-PINCH REACTOR (RTPR). Gerstl, S. A. W. (Argonne National Lab., IL); Persiani, P. J.; Dudziak, D. J. Trans. Amer. Nucl. Soc.; 17: 37-38(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6720 INDUCED RADIOACTIVITY IN THE LITHIUM COOLANT OF THE REFERENCE THETA-PINCH REACTOR (RTPR). Persiani, P. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 38(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6721 FUSION POWER BY NON-MAXWELLIAN IONS IN D–T, D–D, D–^{3}He, AND p–^{11}B SYSTEMS. Bathke, C.; Towner, H.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 17: 41-42(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6722 NEUTRON DIAGNOSTICS FOR LASER-INDUCED FUSIONING PLASMA EXPERIMENTS. Southworth, F. H.; Campbell, H. D. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 17: 42-43(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6723 ENGINEERING DESIGN OF A REFERENCE THETA-PINCH REACTOR (RTPR). Coultas, T. A. (Argonne National

Lab., IL); Krakowski, R. A.; Dauzvardis, P. V. Trans. Amer. Nucl. Soc.; 17: 46-48(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6724 THERMAL, MECHANICAL, AND IRRADIATION RESPONSE OF THE REFERENCE THETA-PINCH REACTOR (RTPR) FIRST WALL. Krakowski, R. A. (Los Alamos Scientific Lab., NM); Coultas, T. A. Trans. Amer. Nucl. Soc.; 17: 48-49(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6725 THERMAL AND HYDRAULIC RESPONSE OF THE REFERENCE THETA-PINCH REACTOR (RTPR) BLANKET. Krakowski, R. A. (Los Alamos Scientific Lab., NM); Coultas, T. A. Trans. Amer. Nucl. Soc.; 17: 49-50(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6726 VACUUM SYSTEM DESIGN FOR A THETA-PINCH FUSION REACTOR. Hess, D. C. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 50-51(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6727 FUEL REPROCESSING FOR FUSION POWER REACTORS. Sabri, Z. A. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 17: 51(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6728 USE OF PARTITIVE ANALYTICAL FORECASTING (PAF) TECHNIQUES FOR FUSION DEVELOPMENT ANALYSIS. Vanston, J. H. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 17: 53-54(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6729 MATERIALS PROBLEMS IN THE DESIGN OF MAGNETICALLY CONFINED PLASMA FUSION REACTORS. Fraas, A. P. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 133(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6730 MATERIALS RADIATION DAMAGE LIMITATIONS IN THE WISCONSIN FUSION REACTOR DESIGN. Kulcinski, G. L.; Brown, R. G.; Lott, R. G.; Sanger, P. A. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 133-135(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6731 RELEVANCE OF VARIOUS NEUTRON SOURCES TO FUSION REACTOR RADIATION EFFECTS. Logan, C. M. (Univ. of California, Livermore); Anderson, J. D.; Munir, Z. A. Trans. Amer. Nucl. Soc.; 17: 135(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6732 EFFECT OF TEMPERATURE ON FIRST-WALL EROSION BY RADIATION BLISTERING. Kaminsky, M.; Das, S. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 135-136(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6733 HELIUM RE-EMISSION AND SURFACE DEFORMATION IN NIOBIUM, VANADIUM, AND MOLYBDENUM. Bauer, W. (Sandia Lab., Livermore, CA); Thomas, G. J. Trans. Amer. Nucl. Soc.; 17: 136-138(Nov 1973).
From joint meeting of theAmerican Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6734 TEM INVESTIGATION OF 14-MeV NEUTRON DAMAGE. Merkle, K. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 138(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6735 TRANSMUTATION EFFECTS IN CTR BLANKETS. Vogelsang, W. F.; Kulcinski, G. L.; Lott, R. G.; Sung, T. Y. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 138-139(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6736 NEUTRON IRRADIATION DAMAGE IN Nb AND Nb–1% Zr. Wiffen, F. W. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 140(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6737 LASER-CONTROLLED THERMONUCLEAR REACTOR MATERIALS REQUIREMENTS. Williams, J. M.; Frank, T. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 141 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6738 EFFECTIVENESS OF TRITIUM REMOVAL FROM LITHIUM BY COLD TRAPPING OF SECONDARY LIQUID METALS Na, K, AND NaK. Natesan, K.; Smith, D. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 141-142(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6739 GRAPHITE FOR CONTROLLED THERMONUCLEAR REACTOR APPLICATIONS. Eatherly, W. P.; Scott, J. L.; Cook, W. H. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 146-147(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Wave Phenomena

Refer also to abstracts 5758, 6694, and 7395.

6740 (CEA-CONF-2383) STRUCTURE OF THE WAVE FIELD NEAR THE HYBRID FREQUENCIES AND APPLICATION TO INCOHERENT SCATTERING. Fichet, M.; Fidone, I.; Granata, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd] 4p. Dep. NTIS (U. S. Sales Only) $3.00.
A plasma slab with a smooth density gradient along x, normal to the faces and to the external magnetic field directed along z, is considered. The special case is considered so that there is no coupling between the two electromagnetic modes in the plasma. The electromagnetic field in the resonance region was also studied. (MOW)

6741 OBSERVATION OF COLLISIONLESS DRIFT WAVES IN A TOROIDAL HEXAPOLE. Nagashima, T.; Tamura, S.; Yamato, H.; Arizono, S.; Ohtsuka, H.; Shiina, T.; Yoshikawa, M.; Mori, S. (Japan Atomic Energy Research Institute, Tokai, Ibaraki-ken, Japan). Phys. Rev. Lett. 31: No. 2, 82-86 (9 July 1973).
We have done an experimental study of low-frequency waves in a low-β plasma confined in a hexapole with and without toroidal field. The identification of the waves and the interpretation of mode transition in poloidal mode number are made in comparison with the results predicted from linear theory with slab geometry. (auth)

6742 MEASUREMENT OF COLLISIONLESS ELECTRON-CYCLOTRON DAMPING ALONG A WEAK MAGNETIC BEACH. McVey, B.; Scharer, J. (Electrical Engineering Department, The University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. Lett. 31: No. 1, 14-17 (2 July 1973).
We present measurements of collisionless spatial cyclotron damping rates and finite minimum wavelengths near resonance. The plasma density and temperature are determined from wavelength data by solving the hot-plasma dispersion relation far away from and near cyclotron resonance. Damping rates determined from resulting plasma parameters agree with the experimentally determined damping rates as well as with those obtained from Langmuir-probe data. (auth)

6743 NONLINEAR INTERACTION OF ELECTROMAGNETIC WAVES IN A PLASMA DENSITY GRADIENT. Kaufman, A.N.;

Cohen, B.I. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 30: No. 26, 1306-1309 (25 June 1973).

Two intense electromagnetic waves interact strongly where the local plasma frequency equals their difference frequency, resulting in an irreversible transfer of action from the higher-frequency wave to the lower-frequency wave. The amount of transfer depends only on the intensities and the density scale length. Successive transfers among a set of waves may produce efficient plasma heating. (auth)

6744 KINETIC THEORY OF BOUNDED BEAM-PLASMA SYSTEMS. Diaz, C. J. Hanover, NH; Dartmouth Coll. (1973). 150p. University Microfilms Order No. 73-27,579.

Thesis (Ph.D.).

A theoretical study of the spectrum of electrostatic field fluctuations and the reaction of these on the particles of a bounded beam-plasma system in the regime below threshold for instability is presented. The beam and plasma uniformly fill a cylindrical (grounded) waveguide. A strong and uniform magnetic field is present along the guide axis. It is assumed that the field is strong enough (infinite) to constrain the particle motion parallel to the axis. In this case, the reaction of the fluctuations back upon the particles may be described by a one dimensional random walk process in velocity space. The Fokker-Planck equation describing such a process is assumed to be the kinetic equation which describes the evolution of the one particle distribution functions. The calculation of the dynamical friction and diffusion coefficients is carried out in detail for the bounded system and the resultant kinetic equation becomes a bounded plasm version of the Balescu-Lenard equation. The fluctuation spectra exhibit peaks in the neighborhood of the roots of the dispersion relation. The spectra exhibit a triplet structure when the beam resonance frequency is near one of the unperturbed plasma eigenmodes. An estimate of the height of the peaks is given. The behavior of the spectra, as the coupling of the beam to the plasma is varied, is shown and explained on the basis of the root locus of the dispersion relation for the bounded system. The problem of stability is also considered: when the dispersion relation predicts one of the roots approaching the real ω-axis from below, it is expected that the peak associated with this root will grow. A full discussion of a typical case when the beam and plasma distributions are Lorentzian is given. Finite magnetic field corrections to the dispersion relation are also presented. The kinetic equation is used to calculate the logarithmic rate of change for the ion distribution. A typical plot of the ion relaxation rate is shown for the case of Lorentzian distributions. The biggest rates occur, as expected, for velocities near synchronism with the phase velocities of the waves predicted by the dispersion relation. The results suggest the tendency of instantaneous ion beamlet formation in these regions of velocity space. As a supplement, the kinetic equation for the bounded system is derived from the first two (closed set of) equations of the BBGKY hierarchy. The infinite magnetic field assumption makes the problem one dimensional in velocity space but three dimensional in the spatial variables. The transverse boundaries are embodied into the theory by noting that the term $1/|r-r'|$ is the Green's function for the unit charge within a grounded cylindrical pipe. (Diss. Abstr. Int., B)

6745 EXPERIMENTAL OBSERVATIONS OF THE BEAM-PLASMA INTERACTION. Conrad, J. R. Hanover, NH; Dartmouth Coll. (1973). 167p. University Microfilms Order No. 73-27,575.

Thesis (Ph.D.).

The wave spectrum and electron velocity distribution function in a beam-plasma system were experimentally observed. The beam electrons excite longitudinal electrostatic waves which propagate below the electron plasma frequency in the bounded plasma column. The experimental observations of the interaction are classified into three regimes. When the beam is weak, the streaming instability can be stabilized by losses in the plasma, and by a decoupling of the beam space charge waves from the natural modes of the plasma column. In this regime below the threshold for exponentially growing waves, the observed wave spectrum consists of a series of triplets, one set of each natural mode of the magnetized, cylindrical, axially bounded plasma column. The lineshape and intensity of the triplets are found to be in good agreement with a simple theory based on the linearized dispersion relation. In this regime, there is negligible scattering of the beam electrons by the beam-excited fields. As the interaction strength is increased, a single mode grows in intensity until beam diffusion (during a beam transit time) reduces the net, axially averaged growth rate to zero. The nonlinear model proposed to account for the saturation of the instability depends strongly on effects due to the axial mode decoupling and on finite transit time effects. The interpretation of the model differs from the usual quasilinear or trapping theories of the beam-plasma instability. In this regime of single mode turbulence the beam diffusion is compared with numerical solutions of a modified Fokker-Planck equation and a coupled nonlinear rate equation for the field. If the strength of the interaction is increased still further, many modes are driven unstable, and the system enters the regime of wideband turbulence. The beam and plasma distributions merge to form a single distribution, and a high energy tail appears in the electron distribution, as beam electrons are stochastically accelerated to several times the beam injection energy. A direct correlation between the field and particle distributions is observed. The production of the high energy tail is associated with the appearance of the low frequency, high phase velocity cavity modes. (Diss. Abstr. Int., B)

6746 OBSERVATION OF AMPLITUDE OSCILLATION OF SECOND-HARMONIC ION ACOUSTIC WAVES. Ohnuma, T.; Fujita, T.; Ohnuki, S.; Nakamura, Y.; Adachi, S. (Department of Electrical Engineering, Tohoku University, Sendai, Japan). Phys. Rev. A 8: No. 2, 1002-1007 (Aug 1973).

For the propagation of an ion acoustic wave, we observed an amplitude oscillation of the second-harmonic ion acoustic wave, which is qualitatively explained by nonlinear wave-wave-coupled theory with a fluid model. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 5206, 6187, and 6449.

6747 (CEA-CONF-2277) MICRODOSIMETRY: APPLICATIONS TO RADIOPROTECTION. de Choudens, H. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 16p. (In French). (CONF-720567-4). Dep. NTIS (U.S. Sales Only) $3.00.

From 7th national congress on the monitoring of ionizing radiations conference; Marseilles, France (16 May 1972).

Microdosimetry is a new technique for radioprotection which is particularly useful and without competition for the dosimetry of mixed fields and high energy radiation beams. The utilization of a LET spectrometer in conjunction with high energy accelerators or for spatial dosimetry of particularly complex radiation compositions is discussed. The development of the microdosimeter has contributed to the alignment of physical measurements and biological observations of the damage caused and thus leads to a deeper understanding of the effects of radiation on tissues. (FR)

6748 (COO-1671-50) TWO-COMPONENT MODEL IN THE THEORY OF RBE. Katz, R.; Sharma, S. C. (Nebraska Univ., Lincoln (USA)). 1972. 14p. (CONF-730952-2). Dep. NTIS $3.00.

From 4th symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

Many investigators have sought to represent cellular survival after gamma-ray irradiation by a two-component model, according to the equation $N/N_0 = e^{-D/D_1}\,[1 - (1 - e^{-D/D_m})^m]$, where D is the dose of gamma-rays, D_1 is the characteristic dose of the 1-hit component and D_m is the characteristic dose of the m-target component. Typically D_1/D_m is about 2. Following the procedures of the delta-ray theory of track structure, the inactivation cross-section of a detector was calculated whose sensitive elements have an appropriate range of sizes, and of values of D_1/D_m and m. For values of D_1/D_m less than 10, the 1-hit component dominates the response of the detector to heavy ions, with the result that the RBE of such a detector should decrease with an increase in the value of z^2/β^2 of the incident radiation. Only when D_1 is very much greater than D_m does the multi-target component dominate the result. Then the inactivation cross-section displays a plateau in the transition from the grain-count regime to the track-width regime. The result is only weakly dependent on the explicit use of the two-component model. It must be expected to arise from any survival curve after gamma-ray irradiation which displays a non-zero initial slope. The inference must be drawn that there is an inherent incompatibility among the following three conditions: (1) the response of a homogeneous population of targets to gamma-radiation may be described by a two-component model with D_1/D_m less than 10, (2) this population displays an RBE greater than 1 after any irradiation (including neutrons) and (3) the delta-ray theory of track structure is applicable to this system without modification for dose-rate effects or for repair mechanisms. (auth)

6749 (COO-1671-52) 1-HIT DETECTOR IN THE MEASUREMENT OF RADIATION QUALITY. Sharma, S. C.; Katz, R. (Nebraska Univ., Lincoln (USA)). 1972. 17p. (CONF-730952-4). Dep. NTIS $3.00.

From 4th symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

The response of a 1-hit detector to an arbitrary radiation field is calculable from 2 numbers, a characteristic dose E_0 and a characteristic dimension a_0. Assignment of these numbers to the Fricke dosimeter from its response to heavy ions and gamma-rays has made it possible to predict its response to neutrons. Of the two parameters, the dose E_0 is dominant in importance, reflecting changes in the detector sensitivity over many orders of magnitude, while a_0 is responsible for sensitivity changes of about factor 2 or less, principally for lighter ions. Typically, the radiosensitivity of 1-hit detectors declines with an increase in LET, is non-linear and multiple valued when plotted as a function of either LET or z^2/β^2. The response is linear with dose at low dose, saturating at doses approaching and exceeding E_0, when irradiated with x-rays. The constellation of 1-hit detectors now includes (at least as candidates) emulsion, scintillators, thermo- and photoluminescent dosimeters, TSEE, the Fricke dosimeter, radical production, enzyme and virus inactivation, darkening of dye-cyanide films, and optical rotation. Differences in the radiosensitivity to heavy ions of different LET as a function of E_0 and a_0 suggest that useful measures of radiation quality can be formed from single or paired 1-hit detectors. Since the response of these detectors and of mammalian cells is calculable from radiosensitivity parameters and of the particle-energy spectrum of a radiation field, it is of interest to examine the possibility that these detectors can be used to achieve an estimate of the equivalent dose in a complex environment. Since the fraction of the dose delivered in the gamma-kill mode, to a cellular population, also declines with LET, an attempt was made to match the RBE of selected 1-hit detectors to the gamma-kill dose fraction, for neutrons, and dispersed beams of charged particles. (auth)

6750 (COO-3243-2) ANNUAL REPORT ON RESEARCH PROJECT. (Columbia Univ., New York. Radiological Research Lab). 1 Jul 1973. Contract AT(11-1)-3243. 370p. Dep. NTIS $10.60.

Summaries of research programs in radiological physics, including dosimetry, microdosimetry and the Radiological Research Accelerator Facility (RARAF), and biophysics and radiobiology are presented. (CES)

6751 (LUIP-CR-73-11) FORMATION OF TRACKS OF FAST HEAVY IONS IN NUCLEAR EMULSION. Jensen, M.; Larsson, L.; Mathiesen, O.; Rosander, R. (Lund Univ. (Sweden). Fysiska Institutionen). Oct 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

A detailed study of the tracks of fast, heavy ions in an electron-sensitive nuclear emulsion of type Ilford G5 was carried out. Using a nuclear track photometer with a narrow slit transverse absorption profiles on 27 tracks of nuclei with charge numbers 14, 16, 20, 24 and 26, covering the velocity interval 0.3c to 0.8c were registered. The charges of the heavy nuclei, emanating from the cosmic radiation, were determined earlier by photometric methods. Theoretical track profiles were computed from the distribution of energy dose around the path of a passing ion. This dose distribution was evaluated according to the delta-ray theory of track structure developed by Katz and co-workers. Utilizing a parameter optimization algorithm, the calculated profiles were fitted to the experimental data. From this comparison one can conclude that a reasonable agreement between experimental and calculated profiles can be obtained if one can adequately compensate for the backscattered light in the emulsion. (auth)

6752 (ORNL-TM-4280) DOT III TWO-DIMENSIONAL DISCRETE ORDINATES TRANSPORT CODE. Rhoades, W. A.; Mynatt, F. R. (Oak Ridge National Lab., Tenn. (USA)). Sep 1973. Contract W-7405-eng-26. 100p. Dep. NTIS $7.00.

The DOT III program uses the method of discrete ordinates to solve radiation transport problems in two spatial dimensions. While suitable for neutral particle transport analysis in fission reactor, CTR, and weapons studies, DOT has been especially developed for large shielding problems involving the transport of neutrons and/or photons. The document gives a full description of input and output data, as well as code implementation information and a description of a few demonstration problems. (auth)

6753 (TID-26432) ENERGY DEPOSITION STUDIES SUMMARY REPORT FOR THE PERIOD ENDING AUGUST 31, 1973. Vroom, D. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 29 May 1973. Contract AT(04-3)-167. 141p. Dep. NTIS $9.25.

The status of research is summarized on the following four main areas: instrument design and construction, photoelectron results, electron impact secondary-electron results, and low-electron-energy excitation results. These results are discussed. (MHR)

6754 ENERGY SPECTRA OF ELECTRONS TRANSMITTED BY THIN SOLID FILMS. Fitting, K.I. (Leningrad Institute of Fine Mechanics and Optics). Sov. Phys.-Solid State 14: No. 11, 2919-2920 (May 1973).

The energy spectra of electrons transmitted by thin films (200-1300 Å) of light metals (Be and Al) and a semiconductor (Ge) were investigated with incident monoenergetic electrons in the range 1-4 keV. (CES)

6755 RELATIVISTIC INVARIANCE AND PHOTON–ELECTRON SCATTERING KERNELS IN TRANSPORT THEORY. Wienke, B. R. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 52: No. 2, 247-253(Oct 1973).

By employing the invariant four-dimensional representation of the photon–electron interaction, obtained from lowest-order quantum electrodynamics, the Compton scattering kernel is easily found in any coordinate frame. This procedure provides a simple

alternative to the usual Lorentz transformation of the scattering kernel (from electron rest frame to frame of interest) used in radiation-hydrodynamics computations and associated moving-media problems in transport theory. Furthermore, arbitrary distributions of electrons can be conveniently handled in this representation, and standard predictions for electrons initially at rest can be recovered easily. (1 figure) (auth)

6756 SKIN CONTAMINATION: DOSE-RATES AT REDUCED DEPTH OF BASAL LAYER. Henson, P. W. (Royal Perth Hospital, Eng.). Brit. J. Radiol.; 46: No. 548, 645-646(Aug 1973).

A table is presented of calculated dose rates in water in Mrad/h at depths of 0.04 mm and 0.07 mm from surface contamination levels equal to the derived working limits (DWL) of 10^{-3} μCi/cm^2 for ^{14}C and ^{35}S and 10^{-4} μCi/cm^2 for ^{32}P, ^{51}Cr, ^{57}Co, ^{58}Co, ^{59}Fe, ^{68}Ga, ^{75}Se, ^{87m}Sr, ^{99m}Tc, ^{113m}In, ^{125}I, ^{131}I, ^{133}Xe, ^{169}Yb, and ^{198}Au. The total dose rates shown include contributions from β^-, β^+, monoenergetic electrons, characteristic x rays, and γ rays. The results are considered in the light of arguments for the basal cell layer of the skin being regarded as situated at a reduced depth of 3 to 5 mg/cm^2, assuming an epidermal density of 1.1 g/cm^3. (UK)

6757 EXCITATION OF ULTRASOUND IN METALS BY A BEAM OF CHARGED PARTICLES. Akhiezer, I. A.; Lazurik-El'tsufin, V. T. (Inst. of Physics and Tech., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 12, 3093-3095(Jun 1973).

Translated from Fiz. Tverd. Tela (USSR); 14: No. 12, 3693-3694(Dec 1972).

Passage of a charged-particle beam through a solid generates acoustic vibrations, either by the Cerenkov mechanism (coupling) or by the dynamic load mechanism (scattering). Calculations are made of the longitudinal load for electron (positron) and proton beams for thin and thick targets. Results are given for 0.01-cm thick plates of Al, Cu, and Pb. (DLC)

6758 INFLUENCE OF TEMPERATURE ON THE SECONDARY ION EMISSION OF A MONOCRYSTALLINE ALUMINUM TARGET. Laurent, R.; Slodzian, G. (Paris Univ., Orsay, France). Radiat. Eff.; 19: No. 3, 181-184(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The secondary ion emission of solid and liquid aluminum versus temperature from 300 to 1000°K was studied with a Slodzian's microanalyser in which the target is horizontal. An increase with temperature of the secondary emission was found in channeling directions and a decrease in the other directions. The behavior of the clusters was also studied. No great difference was found between solid and liquid state for the clusters intensities. A slight difference is found in the energy distribution of secondary ions when the crystal is bombarded in different directions. (auth)

6759 DEPENDENCE OF INELASTIC ENERGY LOSS ON THE ATOMIC NUMBERS OF THE IONS. Baklitskii, B. E.; Parilis, E. S.; Ferleger, V. K. (Inst. of Electronics, Tashkent). Radiat. Eff.; 19: No. 3, 155-160(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The paper provides a general analytical expression for inelastic losses, taking into account the shell effects and also tracing the Z-oscillation of kinetic ion–electron emission from the surface of a crystal and in passage. (auth)

6760 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. V. Finite Order Intensity of Radiation in a Target Slab. Ueno, S.; Vasudevan, R.; Bellman, R. (Univ. of Southern California, Los Angeles). Math. Biosci.; 18: No. 1/2, 55-66(Oct 1973).

In a series of papers invariant imbedding was used to derive the integrodifferential and integral recurrence relations for the finite order scattering and transmission functions, the finite order X and Y functions, by which the diffusely reflected and transmitted intensities of finite order scattered radiation can be numerically computed. Here, the Bellman-Krein-like recurrence relation is extended for the Fredholm resolvent to the derivation of a modified decomposition formula, showing how to express the internal intensities of finite order radiation in terms of the finite order X, Y, f, and g functions. Then, once the finite order X and Y functions have been determined by the use of the preceding methods, making use of the integral recurrence relations for the finite order f and g functions, the numerical solution of the finite order internal radiation field may be obtained. Hence the absorbed dose distribution of finite order gamma radiation and neutron beams can be directly computed. (auth)

6761 CALCULATION PROBLEM OF THE RADIOISOTOPIC TECHNIQUE (CALCULUS OF THE SOLID ANGLE OF RADIATION EMISSION). Pallotti, G.; Seren, E.; Viaggi, F. (Univ., Bologna). J. Nucl. Biol. Med.; 17: No. 1, 5-13(1973).

A method for calculating the solid angle of radioactive emission for different geometrical conditions of target-collimator system is presented. (auth)

6762 MULTIPLE SCATTERING OF CHARGED PARTICLES IN MATTER. Spahn, G.; Groeneveld, K. O.; Meckbach, W. (Univ., Frankfurt am Main). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft on atomic and molecular physics; Munich, Germany (2 Apr 1973).

By means of a position-sensitive Si solid-state counter the multiple scattering was measured for different projectiles with energies between 0.2 and 1.0 MeV/nucleon impinging on solid targets with a thickness between 10 μg/cm^2 and 1 mg/cm^2. The parameters of the measured distribution function are compared with values calculated by the Moliere theory, such as mean-square-width and effective charge. (GE)

6763 IMPLEMENTATION OF BOUNDED POINT ESTIMATORS IN POINT CROSS-SECTION MONTE CARLO CODES. Steinberg, H.; Lichtenstein, H. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 259-260(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6764 MONTE CARLO RADIATION PENETRATION CALCULATIONS ON A PARALLEL COMPUTER. Troubetzkoy, E.; Steinberg, H.; Kalos, M. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 260-261(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6765 APPLICATION OF THE PROBABILITY TABLE METHOD TO MONTE CARLO TEMPERATURE DIFFERENCE CALCULATIONS. Prael, R. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 261-262(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6766 EFFICIENT CALCULATION OF LEGENDRE MOMENTS OF MULTIGROUP ELASTIC SCATTERING TRANSFER MATRICES. Gelbard, E.; Henryson, H. II. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 263-264(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6767 STUDIES OF NEUTRON AND GAMMA-RAY TRANSPORT IN CONCRETE. Cohen, M. O.; Beer, M. (MAGI, Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 523-524(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6768 MONTE CARLO ANALYSIS OF NEUTRON AND GAMMA-RAY TRANSPORT IN CONCRETE. Morrison, G. W.; Petrie, L. M.; Mynatt, F. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 524-525(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6769 INTRODUCTION OF THE GREEN'S FUNCTION IN CROSS SECTION SENSITIVITY ANALYSIS. Albert, T. E. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 546-547(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6770 CALCULATION OF MULTIGROUP CROSS SECTIONS AND TRANSFER MATRICES FOR TARGET NUCLEI WITH ARBITRARY VELOCITY DISTRIBUTIONS. Harris, D. R.; Wallace, J. M. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 548-549(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6771 ANISOTROPIC INELASTIC SCATTERING MATRICES FROM ENDF DATA. Greene, N. M. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 17: 549-550(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6772 CALCULATIONAL ANALYSIS OF NEUTRON AND GAMMA-RAY TRANSPORT EXPERIMENTS IN NITROGEN. Cramer, S. N.; Oblow, E. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 552-553(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6773 SEMIANALYTICAL MODEL FOR HYDROGEN SCATTERING IN MULTIGROUP MONTE CARLO CALCULATIONS. Timmons, D. H. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 17: 553-554(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6774 INVESTIGATION OF RHO-R SCALING FOR RADIATION TRANSPORT IN A DISTURBED ATMOSPHERE. Straker, E. A.; Smith, H. T.; Sargis, D. A. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 567(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6775 RAY EFFECT IN PHOTON DOSE RATES COMPUTED WITH MORSE. Woolson, W. A. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 567-568(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6776 MISSILE TRANSPORT CALCULATION EMPLOYING ANISN AND MORSE WITH OMNIDIRECTIONAL SOURCE. Gibson, F. P. (AMSMI-RRR, Redstone Arsenal, AL); Morrison, G. W. Trans. Amer. Nucl. Soc.; 17: 568-569(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6777 MONTE CARLO CALCULATIONS IN A CURVED-EARTH EXPONENTIAL ATMOSPHERE. Sargis, D. A.; Stevens, C. A. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 569-570(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6778 RADIATION TRANSPORT CALCULATION OF DELAYED RADIATION USING MORSE-II. Burgart, C. E.; Straker, E. A. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 570(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6779 IMPORTANCE OF BREMSSTRAHLUNG IN GAMMA-RAY TRANSPORT. Thompson, W. L. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 571-572(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6780 GAMMA-RAY ALBEDO CALCULATION INCLUDING CONTRIBUTION OF SECONDARY RADIATION. Aslani, E.; Tsoulfanidis, N. (Univ. of Missouri, Rolla). Trans. Amer. Nucl. Soc.; 17: 572-573(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6781 COHERENT SCATTERING AND POLARIZATION EFFECTS ON PHOTON TRANSPORT IN AIR. Roberts, J. P. (Harry Diamond Labs., Washington, DC); Jordan, T. M. Trans. Amer. Nucl. Soc.; 17: 573(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6782 LENGENDRE POLYNOMIAL EXPANSION OF THE KLEIN-NISHINA FORMULA FOR MAXWELLIAN ELECTRONS. Webster, J. B. III (Air Force Weapons Lab., Kirtland AFB, NM); Stephan, B. G.; Bridgman, C. J. Trans. Amer. Nucl. Soc.; 17: 574-575(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6783 ANALYTICAL VACUUM PHOTOEMISSION. Dellin, T. A. (Sandia Labs., Livermore, CA); MacCallum, C. J. Trans. Amer. Nucl. Soc.; 17: 575(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6784 COMPARISON OF PREFLIGHT RADIATION ESTIMATES WITH EXPERIMENTAL RESULTS FOR SKYLAB. Hill, C. W. (Science Applications, Inc., Huntsville, AL); Watts, J. W. Jr.; Burrell, M. O. Trans. Amer. Nucl. Soc.; 17: 575-576(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6785 PROTON TISSUE DOSE ESTIMATION IN COMPLEX GEOMETRIES. Wilson, J. W. (Langley Research Center, Hampton, VA); Khandelwal, G. S. Trans. Amer. Nucl. Soc.; 17: 577-578(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Radiation Protection Standards

Refer also to abstract 4949.

6786 COSTS AND BENEFITS OF NUCLEAR POWER. Dunster, J. (National Radiological Protection Board, Sutton, Eng.). New Sci.; 60: No. 868, 192-194(18 Oct 1973).
Several serious problems stand in the way of the systematic use of cost-benefit analysis in radiological protection. The first of these is the need to assess social costs and benefits which in radiological protection, is complicated by the addition of a major emotional difficulty. In addition, the radiation detriment is delayed for tens of years compared with the time at which expenditure of money and effort is made to control the initiating radiation exposures. Another difficulty to be overcome is the high quality of information required for successful cost-benefit analysis, and the difficulty in extrapolating the observed effects of very large doses delivered in short times to low-level protracted exposure of workers is considered. ICRP have issued recommendations that exposures shall be kept "as low as is readily achievable, economic and social considerations being taken into account". ICRP has also just published ICRP Publication 22 (Pergamon Press, Oxford), in which the application of cost-benefit techniques to the choice of radiation exposure level is worked out in some detail. (UK)

6787 RADIATION PROTECTION IN URANIUM MINES. New York; American National Standards Institute, Inc. (1973). 22p. (ANSI-N13.8-1973).
A standard is presented that covers radiological safety in the mining of ores which are subsequently milled to produce uranium concentrates. (DHM)

Radiation Source Calibration and Standardization

Refer also to abstract 5172.

6788 (BIPM-104) PRACTICAL EVALUATION OF THE BUOYANCY CORRECTION FOR RADIOACTIVE STANDARD SOURCES. Colas, C.; Mueller, J. W. (Bureau International des Poids et Mesures, 92-Sevres (France)). Oct 1967. 5p. Dep. NTIS (U. S. Sales Only) $3.00.
Formulae for determining the buoyancy correction in a quick and simple way are given, providing at the same time a certain uniformity in its evaluation. This correction has to be applied to all absolute mass determinations by weighing, and is required, namely, in the evaluation of specific activities. A formula taking this contribution into account is given for the real weight of a sample measured with a METTLER microbalance. (FR)

6789 (EUR-5038) ABSOLUTE STANDARDIZATION OF THE RADIOACTIVE PAIR ^{95}Zr/^{95}Nb. Hansen, H. H.; De Roost, E.; Van Der Eijk, W.; Vaninbroukx, R. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Oct 1973. 40p. Dep. NTIS (U.S. Sales Only) $4.00. EUR B.Fr. 50,-.
The procedure for the absolute standardization of a ^{95}Zr/^{95}Nb mixture will be described. The age of the radioactive solution has been determined by three independent methods using experimental data of three different measuring devices ($4\pi\beta-\gamma$ coin-

cidence, NaI(Tl), and Ge(Li)). From $4\pi\beta-\gamma$ coincidence counting and γ-ray counting with a calibrated NaI(Tl) crystal two independently obtained results for the original ^{93}Zr activity could be deduced. The adoption of decay properties to be used in the course of the calculations and the consideration of impurities and of error sources have been discussed in some detail. Finally some information on the half-lives of the involved isotopes and on the β-transition probabilities in the decay of ^{93}Zr have been extracted from the experimental data. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 6715, 6716, 6719, 6752, 6862, 6895–6897, 7038, 7039, 7054, 7055, 7168, and 7200.

6790 (CONF-730518-5) HALF-VALUE THICKNESS MEASUREMENTS OF ORDINARY CONCRETE FOR NEUTRONS FROM CYCLOTRON TARGETS. Butler, H. M.; Wallace, K. M.; Fulmer, C. B. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From AIHA conference; Boston, Massachusetts, USA (20 May 1973).

Half-value thicknesses of a wall of ordinary concrete bricks were determined for fast neutrons emitted from a variety of cyclotron beam-target combinations. The neutrons used in the study were produced at the Oak Ridge Isochronous Cyclotron by bombarding thick targets of carbon, aluminum, copper and tantalum with beams of protons, deuterons, alpha particles and carbon ions. Attenuated and unattenuated dose rate measurements of these neutrons were made at an 80 cm thick concrete block wall which served as one side of the target room where the irradiations occurred. The ratios provided by these shielded and unshielded dose rate measurements were translated into half-value thicknesses. (auth)

6791 FAST NEUTRON PENETRATION THROUGH AN AXIALLY-SYMMETRICAL SHIELD. Kozhevnikov, A. N.; Khodakov, V. A.; Khrustalev, A. V. At. Energ. (USSR); 34: No. 6, 487–490(Jun 1973). (In Russian).

The shield is broken up into arbitrary layers with twofold attenuation of neutrons and with corresponding equalization of the neutron attenuation over the shield depth. This procedure was programmed on a computer for shielding computations. From this program it is possible to calculate integral fluxes of neutrons with energies of 0.1 to 14 MeV both within and outside the finite barrier edges of lithium hydride which can be considered as a material consisting of ^{1}H and ^{7}Li atoms. The following interaction processes are taken into account: elastic scattering on hydrogen, elastic scattering on lithium, inelastic scattering on lithium, and absorption. The neutron (E > 1 MeV) attenuation is given as a function of the lithium hydride shield thickness for a plane source of fission neutrons. The fast neutron spectra at various shield depths are presented. In cylindrical, LiH block 45 g/cm^2 thick and 60 cm in diameter the neutron (E > 3 MeV) attenuation is given as a function of the shield-detector distance for neutron sources with various angular distributions. The fast neutron spectra are presented for the same LiH shield block at various distances from its surface with a mono-directed and cosinusoidal sources. Buildup factors are given as a function of the thickness of the cylindrical shield and of its radius (the source is mono-directed; the radii of the source and shield are equal). (SJR)

6792 COMPARISONS OF DETAILED MEASURED AND CALCULATED NEUTRON SPECTRA BEHIND THICK SAMPLES OF IRON. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 522-523(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6793 MEASUREMENT OF THE INTERMEDIATE-NEUTRON SPECTRUM IN A BENCHMARK ASSEMBLY CONTAINING A DOG-LEGGED VOID. Esch, L. J.; Mesh, D. W.; Seemann, K. W.; Levy, A. J. (Knolls Atomic Power Lab., Schenectady, NY). Trans. Amer. Nucl. Soc.; 17: 525-526(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6794 SHIELDING CALCULATIONAL SYSTEM FOR PLUTONIUM. Zimmerman, M. G.; Thomsen, D. H. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 566-567(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

PHYSICS (THEORETICAL)

General

Refer also to abstract 7466.

6795 NONLINEAR-EVOLUTION EQUATIONS OF PHYSICAL SIGNIFICANCE. Ablowitz, M.J.; Kaup, D.J.; Newell, A.C.; Segur, H. (Clarkson College of Technology, Potsdam, New York 13676). Phys. Rev. Lett. 31: No. 2, 125-127 (9 July 1973).

We present the inverse scattering method which provides a means of solution of the initial-value problem for a broad class of nonlinear evolution equations. Special cases include the sine-Gordon equation, the sinh-Gordon equation, the Benney-Newell equation, the Korteweg-de Vries equation, the modified Korteweg-de Vries equation, and generalizations. (auth)

6796 FEYNMAN RULES FOR CHIRAL INTERACTIONS. Davies, P. T. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 11, 1743-1750(Nov 1973).

The steps necessary to set up a perturbation theory for the chiral invariant self-interaction of massless bosons are considered. In each step something different to what one might naively expect from past experience of other interactions is found, but one can decide what the canonical procedures give and then, wherever possible, replace the canonical procedures by the more naive Feynman rules and see what compensation has to be introduced into the interaction. Starting with the ordered hamiltonian given by Charap (J. Phys. A. Math. Nucl. Gen.; 6: 393-408 (1973)), one finds that its use is equivalent to the use of the expected ($-L_{int}$) term, but modified by two singular terms. The first, being proportional to $\delta^4(0)$, is well known. The second, proportional to $(\delta^2(0))^2$, comes from the correct use of Wick's theorem with specified ordering. It is also found that one cannot use normal ordering to rid oneself of tadpole contributions, though this is not because the required normal ordering violates the chiral invariance. It is a characteristic of any such self-interaction theories and therefore has important consequences for many superpropagator calculations. (auth)

6797 GENERALIZED FEYNMAN INTEGRAL. Pardy, M. (Univ., Brno). Int. J. Theor. Phys.; 8: No. 1, 31-37(1973).

The Feynman integral is generalized so as to involve the fluctuations of vacuum, from this integral the generalized Schroedinger equation is derived and the energy spectrum for the Coulomb potential determined. (auth)

6798 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS ENRICO FERMI. Course IL. Foundations of Quantum Mechanics. Course Held at Varenna, Italy, June 29–July 11, 1970. d'Espagnat, B. (ed.). New York; Academic Press, Inc. (1971). 497p. (In Several Languages).

The subject of the discussions presented at the Enrico Fermi Institute is on the borderline between physics and philosophy. The discussions deal with fundamental problems of quantum mechanics, epistemology and everyday life, the basic quantities of various physical theories, and the quantum mechanics of the measurement process. Twenty-four lectures are presented under the following headings: measurement and basic concepts; hidden variables and nonlocality; and interpretation and proposals. (LBS)

6799 CONFORMAL GROUP → SCHROEDINGER GROUP → DYNAMICAL GROUP: THE MAXIMAL KINEMATICAL GROUP OF THE MASSIVE SCHROEDINGER PARTICLE. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Helv. Phys. Acta; 46: No. 4, 496-503(1973).

The 15-parameter nonrelativistic limit of the conformal group and its linear realization in the six-dimensional space are determined. It is shown that the massive free Schroedinger equation is invariant under a 15-parameter set of transformations enlarging the 12-parameter Schroedinger group. It is shown how this set arises from the conformal group, and the quantum-mechanical representation of the generators is determined. (auth)

6800 EXPERIMENTAL MEANING OF THE CONCEPT OF IDENTICAL PARTICLES. Mirman, R. (Long Island Univ., Greenvale, NY). Nuovo Cim., 18B: No. 1, 110-122(11 Nov 1973).

Some of the language used in discussions of identical particles is analyzed and it is found that much of it, along with some of the concepts, is meaningless. The experimental behavior is studied and shown to be a consequence of quantum mechanics without the need for specific assumptions about the behavior of identical particles, as the special characteristics follow from general principles. (auth)

6801 CAUSALITY AND LOCAL ANALYTICITY: MATHEMATICAL STUDY. Bros, J.; Iagolnitzer, D. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Inst. Henri Poincare, Sect. A; 18: No. 2, 147-184(1973).

A generalization of the Laplace transform theorem which uses a nonlinear Fourier transform and which exhibits the equivalence between local analyticity properties and the corresponding essential-support properties of the transformed functions, is presented. A certain class of complex domains (local tubes) is especially suited to the formulation of this theorem. Using these tools, a new and simple approach to the edge-of-the-wedge theorem is presented. This approach allows one to solve the more general problem of boundary values of analytic functions. (auth)

6802 ASYMPTOTIC SOLUTIONS OF INTEGRAL EQUATIONS WITH A CONVOLUTION KERNEL. I. van Trigt, C. (Phillips Research Labs., Eindhoven, Netherlands). J. Math. Phys. (N. Y.); 14: No. 7, 863-873(Jul 1973).

Homogeneous eigenvalue problems for integral equations with a kernel of the convolution type, defined on a finite volume in N-dimensional space, are discussed. It is shown that they can be reduced asymptotically to eigenvalue problems for simpler integral equations. The integral equations to be derived also yield the asymptotic solution of the inhomogeneous problem for the original integral equations. (auth)

6803 INVARIANT IMBEDDING AND ITS APPLICATIONS TO ORDINARY DIFFERENTIAL EQUATIONS. An Introduction. Scott, M. R. Applied Mathematics and Computation. Reading, MA; Addison-Wesley Publishing Co. (1973). 230p. $11.50.

The discussion covers a review of ordinary differential equations and their numerical solution, invariant imbedding, linear boundary-value problems both homogeneous and inhomogeneous, linear initial-value problems, systems of equations, and nonlinear boundary-value problems. (JFP)

6804 QUANTUM MECHANICS: PRINCIPLES AND FORMALISM. International Encyclopedia of Physical Chemistry and Chemical Physics. Topic 2. Classical and Quantum Mechanics, Volume 1. Elmsford, NY; Pergamon Press, Inc. (1972). 166p.

The topics discussed are physical basis of quantum theory, some simple solutions of the Schroedinger equation, mathematical digression, a general formulation of quantum mechanics, and general theory of representations. (JFP)

6805 CALCULATING BESSEL FUNCTIONS WITH PADE APPROXIMANTS. Golden, J. E.; McGuire, J. H.; Nuttall, J. (Texas A and M Univ., College Station). J. Math. Anal. Appl.; 43: No. 3, 754-767(Sep 1973).

The solution of the two-body Schrodinger equation with a C/r^2 potential is a Bessel function. The asymptotic series in r^{-1}, which is generated from Schrodinger equation, has a zero radius of convergence. The Padé approximants to the asymptotic series in $1/z$ for $J_\nu(z)$ converge rigorously for ν real. For ν imaginary convergence appears to be the same as for ν real. (auth)

6806 APPROXIMATE SOLUTIONS TO THE ONE-DIMENSIONAL SCHROEDINGER EQUATION BY THE METHOD OF COMPARISON EQUATIONS. Richardson, M. J. (Department of Chemistry, University of California, San Diego, La Jolla, California 92037). Phys. Rev. A 8: No. 2, 781-795 (Aug 1973).

The method of "comparison equations" for obtaining approximate solutions to the one-dimensional Schrödinger equation is discussed. In this method, one Schrödinger equation, $\psi''(x) + k^2(x)\psi(x) = 0$, is transformed into another, $v''(z) + K^2(z)v(z) = 0$, by a simultaneous change of independent and dependent variables, $x \to z$, $\psi \to v$. Then $\psi(x)$ and $v(z)$ are related by $\psi(x) = v(z)(dz/dx)^{-(1/2)}$ whenever $k^2(x)$ and $K^2(z)$ satisfy the relation $K^2(z)(dz/dx)^2 = k^2(x) - (1/2)\langle z; x\rangle$. Here $\langle z; x\rangle = z'''/z' - (3/2)(z''/z')^2$ is the Schwarzian derivative of z with respect to x and the prime indicates d/dx. A set of "best" criteria for the transformed potential $K^2(z)$ is obtained, where by "best" is meant that we can completely neglect $\langle z; x\rangle$ in first approximation and yet not have the turning-point problems that plague the WKB method (which is a special case of the comparison-equation method). The WKB method sets $K^2(x) \equiv 1$ and neglects $\langle z; x\rangle$; the result is that the transformation $x \to z$, $\psi \to v$ is singular at the turning points, where $k^2(x) = 0$. We choose $K^2(z)$ to have the proper asymptotic behavior far from the turning points, so that $z' \approx 1$; hence $\langle z; x\rangle \approx 0$ in these regions, and we match the zeroes of $k^2(x)$ and $K^2(z)$ in order to keep the transformation regular. This method is applied to various potentials with one and two turning points. Transmission and reflection coefficients T and R and transmitted and reflected phase shifts μ and ν are calculated for potentials with one turning point and potential barriers, and expressed in terms of the energy E and the quantity W =

$|\int_{x_1}^{x_2} k\,dx|$, where $x_{1,2}$ are the possibly complex turning points, $k^2(x_{1,2}) = 0$. Quantization rules, in terms of the classical action, are derived for various types of potential wells. (auth)

6807 QUANTUM MECHANICS AS RELATIVISTIC STATISTICS. I. The Two-Particle Case. Rylov, Y. A. (Inst. of Space Research, Moscow). Int. J. Theor. Phys.; 8: No. 1, 65-83(1973).

It is shown that non-relativistic quantum mechanics can be treated as a kind of relativistic statistical theory, which describes the indeterministic motion of classical particles. The theory is relativistic in the sense that the relativistic notion of the state and two-time equations of motion are used. The principles and relations of quantum mechanics are obtained from the principles of statistics and those of classical mechanics. (auth)

6808 FURTHER STUDIES IN AESTHETIC FIELD THEORY. 2. Equations for $e_{\alpha i}$. Muraskin, M.; Ring, B. (Univ. of North Dakota, Grand Forks). Int. J. Theor. Phys.; 8: No. 2, 85-91 (1973).

In a previous paper (Muraskin, Int. J. Theor. Phys.; 7: No. 3, 213(1973)), a bounded particle in "aesthetic" field theory was obtained. The field equations there are implied by a set of equations for a system of basis vector variables, $e_{\alpha i}$. In this paper, a simpler set of field equations for $e_{\alpha i}$ are proposed. It is found that a bounded particle solution to the equations still appears (as determined by axes runs). The particle appears basically similar to the particle found previously. (auth)

Quantum Field Theories

Refer also to abstracts 5732, 6290, and 6833.

6809 (CRN/HE-73-5) CLASSICAL THEORY OF CHARGED AND SPINNING TACHYONS. Fleury, N.; Leite Lopes, J.; Oberlechner, G. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de la Recherches Nucleaires). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The classical equations of motion of a charged tachyon in an electromagnetic field are postulated. They show that a tachyon which travels backward in time with negative energy behaves as an oppositely charged tachyon travelling forward in time with positive energy. The retarded and advanced fields are divergent at the tachyon world-line and on a surface corresponding to the Čerenkov cone; but the Dirac radiation field is finite at the tachyon world-line and gives rise to a finite energy loss similar to the one computed in the classical electron theory. Finally the Bargmann-Michel-Telegdi equation for classically spinning particles is transcribed in the case of tachyons. (auth)

6810 (JINR-E2-7179) LOCAL PROPERTIES OF DUAL FIELD THEORY. Robaschik, D.; Wieczorek, E.; Oehler, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. Dep. NTIS (U.S. Sales Only) $3.00.

Dual field theory is studied in the simplest case of the two point function where the asymptotic behavior of the spectral function is determined. The exponential growing of the spectral function announces non-local behavior of the theory. (auth)

6811 RELIABLE PERTURBATIVE RESULTS FOR STRONG INTERACTIONS? Politzer, H. D. (Jefferson Physical Laboratories, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett.; 30: No. 26, 1346-1349(25 June 1973).

An explicit calculation shows perturbation theory to be arbitrarily good for the deep Euclidean Green's functions of any Yang-Mills theory and of many Yang-Mills theories with fermions. Under the hypothesis that spontaneous symmetry breakdown is of dynamical origin, these symmetric Green's functions are the asymptotic forms of the physically significant spontaneously broken solution, whose coupling could be strong. (auth)

6812 ULTRAVIOLET BEHAVIOR OF NON-ABELIAN GAUGE THEORIES. Gross, D.J.; Wilczek, F. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 30: No. 26, 1343-1346 (25 June 1973).

It is shown that a wide class of non-Abelian gauge theories have, up to calculable logarithmic corrections, free-field-theory asymptotic behavior. It is suggested that Bjorken scaling may be obtained from strong-interaction dynamics based on non-Abelian gauge symmetry. (auth)

6813 POSSIBLE CONSTRUCTION OF THE QUANTUM FIELD THEORY. Rayski, J. M. Jr. (Uniwersytet Jagiellonski, Krakow). Int. J. Theor. Phys.; 8: No. 1, 39-46(1973).

A method of construction of quantum field theory as a limit of some approximate theories is proposed. The way to find the limit is indicated and discussed in more detail for the free field. Suggestions for interacting fields are also given. (auth)

6814 SCATTERING MATRIX FOR SOME NON-POLYNOMIAL INTERACTIONS. II. Albeverio, S.; Hoeegh-Krohn, R. (Univ. of Oslo). Helv. Phys. Acta; 46: No. 4, 535-545(1973).

The study of the infinite volume limit of quantum field theoretical models in n-dimensional space-time with interaction densities which are bounded functions of an ultraviolet cut-off boson field is continued. The truncated off-shell scattering amplitudes are (in contrast to the on-shell ones) the limits of the correspondent space cut-off quantities. They are analytic in the energy variables outside the union of certain real hyperplanes and have crossing symmetry. Remarks are given on the restriction of the off-shell scattering amplitudes of the physical mass shell. (auth)

6815 UNIFICATION OF GRAVITATION AND ELECTROMAGNETISM. Pandres, D. Jr. (North Georgia Coll., Dahlonega). Lett. Nuovo Cim.; 8: No. 9, 595-599(27 Oct 1973).

In criticizing certain proposed unified field theories Pauli remarked that all these theories are exposed to the objection that they are in disagreement with the principle that only irreducible quantities should be used in field theories. This principle is indeed satisfactory from a formal point of view and has been verified empirically without exception in physics. Therefore, it is believed that cogent mathematical reasons have to be given why a decomposition of the reducible quantities used in the theory does not occur. These are discussed. (JFP)

6816 LORENTZ TRANSFORMATION RELATED TO THE DYNAMICS OF TACHYONS. I. Rachman, A. (Laboratoire de Physique, Poitiers, France); Dutheil, R. Lett. Nuovo Cim.; 8: No. 10, 611-617(3 Nov 1973).

The existence of a meta-transformation belonging to the Lorentz group and specially suitable to describe the transformation properties for particles with spacelike four-momentum is shown, from which it is possible to introduce in a natural form tachyon dynamics and particularly the concept of meta-mass. (JFP)

6817 ASYMPTOTIC STATES IN NONRELATIVISTIC MODELS EXHIBITING INFRA-RED DIVERGENCES. Schweber, S. S. (Brandeis Univ., Waltham, MA). Nuovo Cim.; 18B: No. 1, 83-94 (11 Nov 1973).

A method related to that of Faddeev and Kulish to eliminate infrared divergences is illustrated in some exactly solvable nonrelativistic models. (auth)

6818 THIRRING MODEL. Asymptotical Fields and S-Matrix. Pogrebkov, A. K. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 17: No. 1, 47-56(Oct 1973). (In Russian).

Asymptotic fields and S-matrix for the Thirring model are constructed. It is shown that nonzero local and Lorentz covariant asymptotic fields exist only if the interacting field is densely defined as the bilinear form. Lorentz covariance and spectrality of space-time generators for this bilinear form are proved. It is shown that locality formally takes place only if the coupling constant is equal to $\pm 2\pi\sqrt{2n}$, $n = 0, 1, 2, \ldots$. (auth)

6819 STABILITY OF INTERACTION WITH RESPECT TO SPONTANEOUS PRODUCTION OF AVERAGE BOSON FIELD. Vasil'ev, A. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 17: No. 1, 24-33(Oct 1973). (In Russian).

It is demonstrated by concrete examples, how the stability of interaction with respect to spontaneous production of boson field (scalar or vector) with nonzero vacuum expectation can be tested. In the case of the gauge fields (electrodynamics and the Yang-Mills field) it is shown that the stability is guaranteed by the gauge invariance. (auth)

6820 DISCRETE MODELS. Greenspan, D. Applied Mathematics and Computation. Reading, MA; Addison Wesley Publishing Co. (1973). 175p. $8.50.

The discussion covers discrete model theory, discrete oscillators, nonlinear string vibrations, planetary motion and discrete Newtonian gravitation, the three and the n-body problems, discrete fluid models, symmetry in discrete mechanics, other forms of discrete mechanics, and discrete special relativity. (JFP)

6821 FUNCTIONAL INTEGRATION FOR BOSE FIELDS. Revzen, M.; Schulman, L. S. (Technion-Israel Inst. of Tech., Haifa). J. Statist. Phys.; 8: No. 3, 217-219(Jul 1973).

The Lagrangian occurring in functional integration of bose fields is shown to be made up of two parts, one pertaining to the Bose commutation and the other to the dynamics. (auth)

Gravitation and General Relativity

Refer also to abstracts 5946, 6815, and 6820.

6822 (ORO-3992-137) SHADOW EFFECT: WEYL SOLUTIONS. Chiang, C. C.; Dykla, J. J.; Hwang, A. E. (Texas Univ.,

Austin (USA)). 1973. 6p. (CPT-186). Dep. NTIS $3.00.

The shadow effect in general relativity is applied to obtain an exact static axisymmetric solution containing a naked point singularity with directional behavior. (auth)

6823 CONSERVATION LAWS IN GENERAL RELATIVITY IN THE VIERBEIN FORMALISM. Wong, S. K. (Univ. of Calgary, Alberta). Gen. Relativity Gravitation; 4: No. 4, 327-331(1973).

Conservation laws for dynamical systems in Riemannian space-time in the Vierbein formalism are deduced from the existence of motions in the space-time. The result is applied to Dirac's equation in general relativity. (auth)

6824 SPIN AND TORSION IN GENERAL RELATIVITY. I. Foundations. Hehl, F. W. (Technische Univ., Clausthal-Zellerfeld, Ger.). Gen. Relativity Gravitation; 4: No. 4, 333-349(1973).

From physical arguments space-time is assumed to possess a connection $\Gamma^k_{ij} = \{^k_{ij}\} + S^k_{ij} - S^k_{ji} + S^k_{ij} = \{^k_{ij}\} - K^k_{ij}$. $\{^k_{ij}\}$ is Christoffel's symbol built up from the metric g_{ij} and already appearing in general relativity (GR). Cartan's torsion tensor $S^k_{ij} = \frac{1}{2}(\Gamma^k_{ij} - \Gamma^k_{ji})$ and the contortion tensor K^k_{ij}, in contrast to the theory presented both vanish identically in conventional GR. Using the connection introduced above the consequences for GR in the framework of a consistent formalism are discussed. There emerges a theory describing, in a unified way, gravitation and a very weak spin-spin contact interaction. (auth)

6825 STATIC SOURCES IN THE BRANS–DICKE THEORY. Buchdahl, H. A. (Australian National Univ., Canberra). Gen. Relativity Gravitation; 4: No. 4, 319-326(1973).

In the general theory of relativity the active mass M of a static source can be written exactly as an integral over a certain linear combination of the diagonal components of the stress-energy tensor. Two corresponding integrals are found within the framework of the Brans–Dicke theory (Phys. Rev.; 124: 925(1961)) which give the values of those two constants characterizing the source which alone enter into the metric tensor at points sufficiently remote from the source. After dealing with some concomitant results it is shown that the Brans–Dicke equations do not admit everywhere regular, static, asymptotically flat vacuum solutions. (auth)

6826 LORENTZ COBORDISM. II. Yodzis, P. (Dublin Inst. for Advanced Studies). Gen. Relativity Gravitation; 4: No. 4, 299-307(1973).

It is shown that "changes of topology" (of spacelike sections) in the space-time of classical general relativity are consistent with the following requirements: stable causality, future causal geodesic completeness, and finite, positive energy density. This amounts to showing that the framework of classical general relativity encompasses "changes of topology." (auth)

6827 SATISFACTION OF deDONDER AND TRAUTMAN CONDITIONS BY RADIATIVE SOLUTIONS OF THE EINSTEIN FIELD EQUATIONS. Anderson, J. L. (Stevens Inst. of Tech., Hoboken, NJ). Gen. Relativity Gravitation; 4: No. 4, 289-297 (1973).

It is shown that when the Einstein field equations for the gravitational field are modified by imposing the deDonder coordinate conditions these equations can be "solved" in terms of source functions using the retarded Green's function for the d'Alembertian in flat space. The "solution," which becomes an actual solution in the fast-motion approximation, is shown to satisfy the deDonder conditions if and only if the stress-energy tensor of the sources of the gravitational field is covariantly conserved. It is also shown to satisfy the Trautman (Bull. Acad. Polon. Sci.; 6: 627(1958)) outgoing radiation condition. (auth)

6828 NEW THEORETICAL TECHNIQUES IN THE STUDY OF GRAVITY. Fischer, A. E.; Marsden, J. E. (Univ. of California, Santa Cruz). Gen. Relativity Gravitation; 4: No. 4, 309-317(1973).

Using new methods based on first order techniques, it is shown how sharp theorems for existence, uniqueness, and continuous dependence on the Cauchy data for the exterior Einstein equations can be proved simply and directly. The main tools are obtained from the theory of quasi-linear first order symmetric hyperbolic systems of partial differential equations. Einstein's equations in harmonic coordinates are cast into this form, thus achieving a certain uniformity of the description of gravity with other systems of partial differential equations occurring frequently in mathematical physics. In this symmetric hyperbolic form, the Cauchy problem for the exterior equations is easily resolved. Similarly, using first order techniques, a uniqueness theorem can be proved which increases by one the degree of differentiability of the coordinate-transformation between two solutions of Einstein's equations with the same Cauchy data. Finally it is shown how the theory of first order symmetric hyperbolic systems admits a global intrinsic treatment on manifolds. (auth)

6829 MACROSCOPIC BODIES WITH ZERO REST MASS. Andreev, A. F. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1303-1310(Oct 1973). (In Russian).

A solution of the general relativity equations is found which describes a macroscopic body of zero rest mass. Such a body moves as a whole with the velocity of light and can emit electromagnetic waves only if it interacts with outside particles. (auth)

6830 GRAVITATIONAL WAVES EMITTED BY A RAPIDLY ROTATING DROP OF A HOMOGENEOUS GRAVITATING LIQUID. Fedosov, M. N.; Tsvetkov, V. P. (Kalinin State Univ., USSR). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1289-1293(Oct 1973). (In Russian).

The intensity of gravitational wave emission is calculated for a rapidly rotating drop of a homogeneous gravitating liquid which acquires the shape of a triaxial ellipsoid. (auth)

6831 SEARCH FOR GRAVITATIONAL RADIATION OF NON-TERRESTRIAL ORIGIN. Braginskii, V. B.; Manukin, A. B.; Popov, E. I.; Rudenko, V. N. (Moscow State Univ.). Phys. Lett.; 45A: No. 4, 271-272(8 Oct 1973).

The results of a new radiation-gravitational experiment are briefly described. Weber's effect of "coincident events" exceeding the statistically expected value is not observed on the level ~5 × 10^6 erg/sec cm^2 for the gravitation energy flux. (auth)

6832 CHARGED DUST SPHERES IN GENERAL RELATIVITY. Vickers, P. A. (Queen Elizabeth Univ., London). Ann. Inst. Henri Poincare, Sec. A; 18: No. 2, 137-146(1973).

The Einstein–Maxwell equations corresponding to a nonstatic spherically symmetric distribution of charged dust is studied and the general solution is presented in an implicit form. The solutions are matched over a boundary to the Reissner–Nordstroem solution, and the equations governing the collapse are examined. The general solution to find the conditions on the parameters that will allow a gravitational bounce for a particular comoving layer is examined. (auth)

6833 SO-CALLED PALATINI METHOD OF VARIATION IN COVARIANT GRAVITATIONAL THEORIES. El-Kholy, A. A.; Sexl, R. U.; Urbantke, H. K. (Univ., Vienna). Ann. Inst. Henri Poincare, Sect. A; 18: No. 2, 12-131(1973).

A review and discussion is given of what has been called the Palatini method of variation of the action integral in several covariant theories of gravitation. There are at least two versions of this method: one of them gives metric affinities in all cases, i.e., the (strong) principle of equivalence; the other one leads to deviations in some cases, among the effects of which there are causal anomalies. It is shown how, with spinorial affinities treated in the second way, gravity and electromagnetism can be unified. (auth)

6834 ELECTROMAGNETIC AND GRAVITATIONAL WAVES IN A STATIONARY MAGNETIC FIELD. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1311-1315(Oct 1973). (In Russian).

The interaction between electromagnetic and gravitational waves in an external stationary magnetic field is investigated. In the strictly coherent case the transformation of one wave into another is complete. (A particular case of this process is the effect discovered by Gertsenshtein.) In the presence of matter refraction of electromagnetic waves restricts the coherence length and the effect practically disappears. (auth)

6835 LAPLACE AND POISSON EQUATIONS IN SCHWARZSCHILD'S SPACE–TIME. Persides, S. (Univ. of Thessaloniki, Greece). J. Math. Anal. Appl.; 43: No. 3, 571-578(Sep 1973).

The method of separation of variables is used to solve the Laplace equation in Schwarzschild's space–time. The solutions are given explicitly in series form and in terms of Legendre functions. Green's function is determined, and remarks are made on the solution of Poisson's equations for a point source. (auth)

6836 A SYMMETRY OF PETROV-TYPE N SPACES. Sigal, R. (Theoretical Physics Institute, University of Alberta, Edmonton, Alberta, Canada). J. Math. Phys. (N.Y.) 14: No. 10, 1434-1436 (Oct 1973).

It is shown that for empty Petrov-type N spaces the Lie derivative in the principal null direction of the Weyl conformal tensor and its dual is equal to a conformal transformation and a duality rotation of the original tensor. This type of symmetry is studied for general relativity and electromagnetism. (auth)

REACTOR TECHNOLOGY AND REGULATION

6837 (STI/PUB-194/6) POWER AND RESEARCH REACTORS IN MEMBER STATES. (International Atomic Energy Agency, Vienna (Austria)). 1973. 103p. IAEA $4.00.

Tables are presented giving information on power and research reactors in operation, under construction, or planned in member states. A reactor name index is included. (JMR)

6838 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1973 WINTER MEETING, SAN FRANCISCO, CALIFORNIA, NOVEMBER 11–15, 1973. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc.; 17: 1-578(Nov 1973). (CONF-731101-).

Included are 612 brief summaries of papers on various aspects of nuclear science and technology. The summaries were presented in technical sessions entitled: Aerospace and Hydrospace; Civil Explosion Application; Controlled Nuclear Fusion; Education; Environmental Sciences; Isotopes and Radiation; Materials Science and Technology; Mathematics and Computation; Nuclear Criticality Safety; Nuclear Fuel Cycle; Nuclear Reactor Safety; Power; Reactor Operations; Reactor Physics; Remote Systems Technology; and Shielding and Dosimetry. Each summary is listed separately in NSA. (TFD)

For abstracts of individual papers see: 4804–4813, 4846–4855, 4861, 4915–4925, 4963–4971, 4996–4998, 5003, 5004, 5014–5019, 5025–5033, 5054–5058, 5065–5091, 5109–5114, 5123–5126, 5132, 5144, 5146–5150, 5156, 5192–5197, 5210, 5226–5228, 5236, 5237, 5240, 5241, 5249, 5253, 5254, 5272–5276, 5326–5328, 5367, 5377, 5391, 5424–5435, 5443–5451, 5460, 5461, 5519–5527, 5549–5560, 5586–5588, 5590–5608, 5613–5621, 5633–5648, 5654–5665, 5692, 5725–5731, 5749, 6071, 6072, 6117, 6118, 6407–6428, 6465–6467, 6586–6594, 6639–6642, 6656, 6687–6690, 6714–6739, 6763–6785, 6792–6794, 6839–6841, 6845–6862, 6871–6897, 6901–6906, 6909, 6918–6959, 6992–7043, 7049–7055, 7118–7168, 7202–7217, 7221–7226, 7229–7234, 7273–7282, 7336–7343, 7367–7370, 7377–7380, and 7394.

6839 POWER PROJECT INTERFACES: THE A/E'S VIEW. Heisler, S. I. (Bechtel Power Corp., San Francisco). Trans. Amer. Nucl. Soc.; 17: 390(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6840 CONSULTANT'S VIEWPOINT OF THE PROJECT INTERFACE RELATIONSHIPS. Pashos, T. J. (Nuclear Service Corporation, Campbell, CA). Trans. Amer. Nucl. Soc.; 17: 390-391(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6841 ARCHITECT/ENGINEER-NUCLEAR VENDOR-UTILITY INTERFACE. Retallick, F. D. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 391-392(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 5030, 7059, 7061, 7063, 7073, 7086, 7093, 7097, 7117, 7133, 7158, 7161, 7162, 7167, 7236, 7273, 7274, 7276, 7282, 7291, 7292, 7294–7300, 7303–7306, 7316, 7318, 7319, 7322, 7324, and 7325.

6842 (CONF-730414-P2, pp IX.31-IX.41) EFFICIENCY OF VARIOUS METHODS FOR THE ANALYSIS OF SPACE TIME KINETICS. Birkhofer, A.; Werner, W. (Technische Univ., Munich). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The relative merits of 3 types of approximations in the analysis of transients in large LWR are evaluated. For fast transients with reciprocal periods >0.5, and time steps <20 msec, Du Fort–Frankel type approximations are fast and sufficiently accurate, if the functional increment per step is limited by 0.6%. For larger time steps (in slow transients) and/or larger increments (if permissible by feedback mechanism) a suitable fully implicit matrix-decomposition method is very efficient. For long-time simulation of large LWR cores, a coarse mesh finite-difference method is used, utilizing analytical representation of fluxes in individual boxes for computation of coupling coefficients. 5 references. (auth)

6843 COMPUTERIZED TRAVERSING IN-CORE PROBE (TIP) SYSTEM OF THE DODEWAARD NUCLEAR POWER PLANT. Termaat, K. P. (N. V. GKN, Arnhem, Netherlands). pp 743-755 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

An accurate evaluation of characteristic reactor physics and thermal-hydraulic parameters in a power reactor is necessary for the safe and efficient operation of the plant. Moreover optimum conditions of core power and fuel-cycle length can then be attained. In the Dodewaard Boiling Water Reactor (58 MW(e)) a Traversing in-core probe (TIP) system produces eight axial thermal neutron flux profiles, which form the basis for this core performance evaluation (CPE). The original layout of this TIP system was only capable of producing graphically neutron flux values versus detector position in the core. A time-consuming hand calculation had to follow, resulting in moderate accurate typical reactor data. By digitalizing the analog TIP signals (neutron flux and axial position) and storing on paper tape, the core performance evaluation is now done off-site on a 16 K computer. This automatization has highly increased the functions of the TIP system. Now, accurate typical reactor operating data, e.g. the total peaking factor, maximum fuel bundle power, exit void fraction, minimum critical heat flux ratio, and burnup are reliably obtained. Moreover, manpower is reduced and the results can be easily and accessibly stored. (auth)

6844 DISMANTLING OF THE ELK RIVER BOILING WATER REACTOR. Manion, W. J. (Gulf United Nuclear Fuels Corp., Elmsford, NY); Jones, J. W.; Pulliam, R. W. Conf. Remote Syst. Technol., Proc.; No. 21, 91-103(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

Dismantling of the Elk River Reactor requires the extensive use of remotely operated tooling. This tooling includes mechanical and flame cutting equipment. The flame cutting method selected for the work is the plasma arc technique which permits single-pass cutting of metal up to three inches thick. Because of high radiation levels, positioning and translation of the torch over the work is done automatically. Plasma cutting will be performed underwater and in-air. In-air cutting of radioactive components will require contamination control by means of an enclosure or envelope which is exhausted through high efficiency filters by a high capacity blower. (auth)

6845 IN-REACTOR DENSIFICATION EXPERIENCE WITH GULF UNITED FUEL. Holden, R. B. (Gulf United Nuclear Fuels Corp., Elmsford, NY); Fuhrman, N.; Raven, L. Trans. Amer. Nucl. Soc.; 17: 169-170(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6846 IRRADIATION PERFORMANCE OF SOLID AND ANNULAR PELLET PLUTONIUM RECYCLE FUELS. Bishop, D. M.; Ogawa, S. Y.; O'Neill, G. L. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 17: 220-221(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6847 FAST RUNNING COMPUTER PROGRAM FOR THERMAL-NEUTRON CELL CALCULATIONS. Karppinen, J.; Saastamoinen, J. (Technical Research Centre, Otaniemi, Finland). Trans. Amer. Nucl. Soc.; 17: 262-263(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6848 OPERATIONAL DATA FROM THE DRESDEN 1 PLUTONIUM DEMONSTRATION PROGRAM. Hamilton, G. ; Wan, M. (Gulf United Nuclear Fuels Corp., Elmsford, NY). Trans. Amer. Nucl. Soc.; 17: 293-294(Nov 1973).

From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6849 EXPERIMENTAL CONFIRMATION OF MIXED-OXIDE DESIGNS. Busselman, G. J. (Exxon Nuclear Co., Inc., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 294(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6850 UTILIZATION OF PLUTONIUM IN A UTILITY POWER SYSTEM. Cherry, B. H. (GPU Service Corp., Parsippany, NJ). Trans. Amer. Nucl. Soc.; 17: 294-295(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6851 BWR PLUTONIUM RECYCLE. Crowther, R. L.; Hopkins: G. C.; Lam, S. K.; Sawyer, C. D.; Wolters, R. A. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 17: 297-298(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6852 OPTIMIZATION OF REFUELING SCHEDULE FOR LIGHT-WATER REACTORS. Motoda, H. (Hitachi Ltd., Kawasaki, Japan); Herczeg, J.; Sesonske, A. Trans. Amer. Nucl. Soc.; 17: 307-308(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6853 RELATIONSHIP BETWEEN NUCLEAR FUEL CYCLE PHYSICAL VARIABLES FOR SMALL PROCESS VARIATIONS. Fuller, E. D. (General Electric Corp., San Jose, CA); Shen, C. N.; Wicks, F. E. Trans. Amer. Nucl. Soc.; 17: 315-316 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6854 NOISE ANALYSIS INVESTIGATION APPLICABLE FOR REACTOR DIAGNOSTICS. Stegemann, D.; Gebureck, P.; Jaschik, W.; Mika, C.; Mikulski, A.; Raes, K. H.; Seifritz, W. (Inst. fuer Kerntechnik, Hanover). Trans. Amer. Nucl. Soc.; 17: 377-378(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6855 MODULAR DESIGN REDUCES NUCLEAR POWER PLANT CONSTRUCTION TIME. Kalk, W. A. (Ralph M. Parsons Co., Los Angeles); Renner, W. A.; Wade, G. E. Trans. Amer. Nucl. Soc.; 17: 386(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6856 RECENT FRACTURE TOUGHNESS AND FRACTURE INVESTIGATIONS OF THE USAEC HEAVY-SECTION STEEL TECHNOLOGY (HSST) PROGRAM. Merkle, J. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 401-402 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6857 FRACTURE BEHAVIOR OF THICK-WALLED VESSELS. Canonico, D. A. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 402-403(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6858 RADIONUCLIDE BALANCES AT A BOILING WATER REACTOR. Cline, J. E.; Pelletier, C. A.; Keller, J. H. (Nuclear Environmental Services, Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 411(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6859 STATUS OF ART IN BURNOUT PREDICTIONS FOR BWR ROD BUNDLES. Guarino, D.; Marinelli, V.; Pastori, L. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 17: 427-428(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6860 ON-LOAD MONITORING OF LOCAL STEAM VELOCITY IN BWR CORES BY NEUTRON NOISE ANALYSIS. Seifritz, W. (Technische Univ., Hanover); Cioli, F. Trans. Amer. Nucl. Soc.; 17: 451-453(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6861 EXPERIMENTAL DETERMINATION OF BURNUP AND HEAVY ISOTOPES AT LWR POWER STATIONS. Brand, P. (N. V. tot Keuring van Elektrotechnische Materialen, Arnhem, Netherlands); Cricchio, A. Trans. Amer. Nucl. Soc.; 17: 473-474 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6862 NEUTRON AND GAMMA-RAY DISTRIBUTIONS IN AND AROUND A LARGE POWER REACTOR DURING NORMAL OPERATION. Gritzner, M. L.; Simmons, G. L. (JRB Associates, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 558-560(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 5030, 5033, 6842, 6845, 6847, 6850, 6852, 6853, 6856, 6857, 6861, 6862, 6916, 7058, 7059, 7063, 7073, 7080, 7093, 7103, 7104, 7117, 7133, 7134, 7156–7159, 7167, 7197, 7240, 7246, 7249, 7254, 7268, 7290, 7293, 7301, 7307–7315, 7317, 7320, 7321, and 7323.

6863 (AEEW-M-1220) COMPARISON OF THE ABSORPTION OF NEUTRONS BY FISSION PRODUCTS IN SGHWR AND PWR LATTICES. Halsall, M. J.; Fayers, F. J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Aug 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.
The present basis of the treatment of fission products within the WIMS lattice code is described. Besides a detailed scheme containing 33 products, an approximate more rapid scheme using 7 pseudo-products is also described. These schemes are then examined in the context of typical SGHWR and PWR fuel cycles to determine the fractions of neutrons absorbed in fission products as a function of burnup, and the consequent effects on reactivities in each case. It is found that an uncertainty in cycle length of $\pm 3\frac{1}{2}\%$ arises from a suggested uncertainty of $\pm 10\%$ in capture cross-sections for the products. It is shown that the pseudo-product scheme achieves adequate accuracy for design calculations. (auth)

6864 (CONF-730414-P1, pp II.113-II.129) KEY CONSTRAINTS FOR SIMULATION OF NUCLEAR FUEL MANAGEMENT. Brown, M. L.; Mingle, J. O.; Eckhoff, N. D. (Kansas State Univ., Manhattan). 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
In mathematical models and computational techniques for analysis of nuclear systems.
A common practice in nuclear fuel management is to view all nuclear fuel requirements as a result of a sequence of independent events. Further, poison and fuel management are considered to be separable. In this work these common assumptions are used to construct a linear programming model of the refueling-shuffling aspects of a PWR. Key constraints used while minimizing costs in this model are energy removal limitations, neutronic restrictions, and reloading time requirements. Partial identity of each fuel element is retained by using spatial zones and burnup groups. It is found that an equilibrium core is never established and that the limiting constraint often varied for each burn period. 29 references. (auth)

6865 (CONF-730414-P1, pp III.3-III.22) METHOD OF CHARACTERISTICS FOR SOLVING TWO-DIMENSIONAL REACTOR CORE FLOWS. Spencer, A. C. (Westinghouse Electric Corp., Pittsburgh, PA). 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

By use of three-dimensional characteristics (two-space dimensions and one-time dimension), a system of compatibility equations equivalent to the mass, momentum and energy conservation equations are numerically integrated along bicharacteristic curves. Included are results which are compared directly with analytical solutions and results representative of possible reactor core transients during accident conditions. 5 references. (auth)

6866 (CONF-730414-P1, pp III.23-III.34) COARSE MESH REBALANCING APPLIED TO HYDRAULIC ANALYSIS. Nakamura, S. (Ohio State Univ., Columbus); Esposito, V. J. 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The MAC methodology for approximating the governing conservation equations is combined with the coarse-mesh rebalancing iterative technique to efficiently solve three-dimensional flow fields. This method can be used as an engineering tool for analyzing complex flow situations. Results are presented showing the computer time savings that can be realized using the coarse-mesh technique in hydraulic analyses. 10 references. (auth)

6867 (CONF-730414-P1, pp III.35-III.51) POTENTIAL FLOW THEORY OF A PRESSURIZED WATER REACTOR. Yeh, H. C.; Tong, L. S. (Westinghouse Electric Corp., Pittsburgh, PA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The profiles of the coolant flow velocity field in the reactor vessel plenums are required to evaluate the stresses imposed on the control rod guide bushings and instrumentation thimble guides in a pressurized water reactor. Flow velocity profiles were obtained analytically with the absence of internals for three regions: the upper plenum, the annular downcomer and the lower plenum. The velocity profiles in the upper plenum and the annular downcomer were calculated by the method of separation of variables for three dimensional geometries. The velocity profile in the lower plenum was solved by conformal mapping for two dimensional geometry. (auth)

6868 IMPORTANCE AND USE OF IN-CORE VIBRATION AND PRESSURE MEASUREMENTS TO DETERMINE CORRECT BEHAVIOR OF PRESSURE VESSEL INTERNALS. Bauernfeind, V. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.); Dio, W. H.; Pink, W. pp 111-121 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

During operation the internals of the reactor pressure vessel perform vibrations excited by the coolant flow. Information for solving these problems is obtained by investigations of the type performed at the Stade Nuclear Power Plant. These investigations included both the motion measurements of core internals at significant positions and the pressure fluctuation measurements at various locations of the reactor coolant system. By statistical methods of evaluation (correlation analysis) the fluctuations can be investigated with respect to their importance as forcing function for the flow-induced motion of the reactor internals. In interpreting the experimental results it was possible to estimate the intensity and the direction of propagation of the pressure fluctuations. By using noise analysis, the correlation between the signals of the driving forces (pressure fluctuation) and those of motion, can be demonstrated. In addition, the models under consideration should be confirmed by applying a theoretical transfer function in comparing with the measurements. (auth)

6869 BURST SLUG DETECTION SYSTEM OF THE NOVOVORONEZH-1 WATER COOLED AND MODERATED REACTOR. Aksenov, V. A.; Batenin, I. V.; Borisov, Yu. A.; Golubev, L. I.; Kruglov, V. P.; Samojlov, S. N. (State Scientific Research Inst. of Instrumentation, Moscow). pp 169-174 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The operation of a bypass system for detecting burst fuel elements by delayed neutron monitoring in the water moderated and cooled reactor of the first unit at the Novovoronezh Nuclear Power Station is described. A bypass detection system was chosen for reactors of this type for the following reasons: (1) difficulties associated with having several openings in the pressure vessel and the complicated core design necessary when coolant is sampled channel by channel; (2) good compatibility of fuel and coolant; (3) possibility of operating the reactor with a high specific coolant activity, which permits continued operation with defective fuel elements as in gas cooled systems; and (4) possibility of using the neutron field overcompensation method to find regions with defective elements. The reactor has six circulation loops. A sample is taken from the headers of the main circulating pumps and is delivered to the sensors of the detection system within 60-80 seconds. After passing through the measuring vessels, the samples are returned to the inlet of the same pumps. The sampling system includes a regulating valve. The sensors of the detection system are located in a control area where the background is low and to which operating staff have access. The delayed neutron method was preferred. The detection units are corona thermal neutron counters, which are virtually insensitive to gamma radiation. A circuit diagram of the electronic equipment is provided. The burst slug detection system fulfills the following functions: (a) with the reactor operating at a steady level, it assesses the state of the core and detects new leaks as they occur; (b) with the reactor neutron field overcompensated, it locates regions where there are defective cassettes. The results obtained with the burst slug detection system in the Novovoronezh-1 reactor are presented. (auth)

6870 NEW INSTRUMENTATION FOR START UP MEASUREMENTS IN PWR REACTORS. Janikowski, A.; Kosycarz, A.; Krzycki, A.; Ostrowski, A. R. (Instytut Badah Jadorowych, Poland). pp 699-709 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The problem of neutron measurements in a PWR reactor is briefly presented. High gamma radiation background, a wide range of neutron flux change, radiation damage of materials used, and a high level of electrical interference, are the main difficulties in obtaining true measurement results. One possible solution to the problem is the use of a fission chamber as the detector. For this purpose a special high sensitivity fission chamber was designed. It works as a pulse detector at low neutron flux level and as a current detector at high neutron flux values. A channel specially developed for these measurements is described. A typical pulse channel with transformer link between detector and amplifier was taken and modified. Some solutions of the channel construction are briefly described. The channel has been tested in normal conditions of PWR power plant operation. The most important measurement results are given and discussed. Chosen performance data of neutron detectors used in the measurements are given and some construction details providing higher reliability and greater resistance against electrical interference are discussed. (auth)

6871 MODEL OF CRUD AND RADIATION-LEVEL BUILDUP IN REACTOR PLANTS. Beal, S. K. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 17: 163(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6872 SYNTHESIS TECHNIQUES FOR LARGE PWR CORE CALCULATIONS. Hassan, H. H. (Babcock and Wilcox Co., Lynchburg, VA); McClure, J. A. Trans. Amer. Nucl. Soc.; 17: 228-229(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6873 CALCULATION OF THE EFFECTIVENESS OF DELAYED NEUTRONS IN COMMERCIAL PWRS. Pilat, E. E. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 17: 255-256 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6874 IMPROVED PLUTONIUM RECYCLE CAPABILITIES. Hanson, G. E.; Jones, H. M.; Tulenko, J. S. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 296(Nov 1973).

From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6875 PLUTONIUM FUEL MANAGEMENT OPTIONS IN LARGE PRESSURIZED WATER REACTORS. Hellens, R. L.; Shapiro, N. L. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 17: 297(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6876 PLUTONIUM RECYCLE IN WESTINGHOUSE PWRS. Hill, D. J.; Henderson, R. R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 298(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6877 CORE PHYSICS CALCULATIONS FOR SAN ONOFRE UNIT 1. Flournoy, W. G. (Southern California Edison Co., Los Angeles); Deng, S. F.; Shen, P. K.; Sullivan, R. P. Trans. Amer. Nucl. Soc.; 17: 305-306(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6878 IN-CORE FUEL MANAGEMENT USING PERTURBATION THEORY AND LINEAR PROGRAMMING. Mingle, J. O. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc.; 17: 306-307(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6879 OPTIMIZATION OF PWR LOADING PATTERNS BY REFERENCE DESIGN PERTURBATIONS. Federowicz, A. J. (Westinghouse Electric Corp., Pittsburgh); Stover, R. L. Trans. Amer. Nucl. Soc.; 17: 308-309(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6880 EFFECT OF CARRYING CHARGES ON INCREMENTAL ENERGY COST AND OPTIMUM REFUELING POLICY. Rothrock, R. B.; Omberg, R. P. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 312(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6881 SAFETY FUNCTION AND PROTECTION SEQUENCE ANALYSIS. Fortney, R. A. (EDS Nuclear Inc., San Francisco); Howard, J. E.; Larson, W. W.; Snedeker, J. T. Trans. Amer. Nucl. Soc.; 17: 339-340(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6882 SURVEILLANCE SYSTEMS FOR NUCLEAR POWER PLANTS. Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 378(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6883 NEUTRON NOISE MEASUREMENTS AT OCONEE I. Lewis, R. H.; McAdams, V. D.; Penland, J. R. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 378-379(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6884 ANALOG SIMULATION OF DESIGN TRANSIENTS FOR A B AND W NUCLEAR STEAM SYSTEM WITH ISOLATED PRIMARY LOOP. Pop, M. G. M. (Ministry of Electric Power, Bucharest); Galan, V. J. Trans. Amer. Nucl. Soc.; 17: 385-386(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6885 INDIAN POINT UNIT NO. 2 STARTUP: ROLE OF UTILITY NUCLEAR ENGINEERS. Imai, M.; Ginsberg, A. P.; Horn, R. X. (Consolidated Edison Co., New York). Trans. Amer. Nucl. Soc.; 17: 437(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6886 OCONEE UNIT 1: WATER CHEMISTRY. Koehler, R. M. (Duke Power Co., Seneca, SC); Beach, R. R.; Hallman, D. F.; Pocock, F. J. Trans. Amer. Nucl. Soc.; 17: 437-438 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6887 EXPERIMENTAL DETERMINATION OF LOCAL PERTURBATIONS RESULTING FROM FUEL GAPS. McAdams, V. D.; Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 448(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6888 PREDICTED AND MEASURED LOCAL POWER PEAKING DUE TO INTERPELLET GAPS. Bennett, C. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 468(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6889 EXPERIMENTAL VERIFICATION OF THE 3-D COARSE-MESH METHOD OF ROBINSON AND ECKARD. Robinson, C. P.; Lee, R. R. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 17: 476(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6890 MEASUREMENT AND ANALYSIS OF CORE PHYSICS PARAMETERS: A UTILITY VIEWPOINT. Purohit, S. N.; Ginsberg, A.; Lee, M. L. (Consolidated Edison Co., New York). Trans. Amer. Nucl. Soc.; 17: 501-502(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6891 IN-CORE AND OUT-CORE FLUX RELATIONSHIPS IN OCONEE 1. Kane, E. R.; Worsham, H. J. Jr.; Bailey, J. A. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 502-503(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6892 REVIEW OF COMBUSTION ENGINEERING STARTUP PHYSICS TESTING. Stuart, M. R. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 17: 504-505(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6893 CONSISTENT MEASUREMENTS OF CONTROL ROD WORTHS IN PWRS. Gruen, A. E. (Kraftwerk Union Aktiengesellschaft, Erlangen, Ger.). Trans. Amer. Nucl. Soc.; 17: 505(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6894 WESTINGHOUSE PWR STARTUP PHYSICS TESTING. Langford, F. L. Jr. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 505-506(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6895 RADIATION LEVEL PREDICTIONS FOR SHIELDING OF PRESSURIZED WATER REACTORS. Avery, A. F. (United Kingdom Atomic Energy Authority, Winfrith, Eng.); Warman, E. A.; Ingeneri, S. M.; Miller, R. C. Trans. Amer. Nucl. Soc.; 17: 555 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6896 ANALYSIS OF THE MAJOR GAMMA-RAY SOURCES IN A PWR PRIMARY SHIELD. Sapyta, J. J. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 17: 557-558 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco; California, USA (11 Nov 1973). See CONF-731101-.

6897 PWR SHIELD HEATING ANALYSIS. Schwab, G. V.; Normand, E. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 17: 562(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 5395, 5472, 7059, 7060, 7095, 7098–7101, 7113, 7116, 7137, 7247–7250, and 7326–7335.

6898 (EUR-5022) COSTANZA HRB: A TWO DIMENSIONAL DYNAMIC PROGRAMME FOR HIGH TEMPERATURE GAS COOLED REACTORS AND ITS APPLICATION TO THE THTR 300-MWe POWER PLANT. Friedrich, K.; Infuehr, E.; Massimo, L.; Vincenti, E. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F.R. Germany)). Sep 1973. 71p. Dep. NTIS (U.S. Sales Only) $5.75. EUR B.Fr. 100,-.

COSTANZA-HRB is a computer code for two dimensional reactor dynamic calculations in cylindrical RZ geometry and two energy groups, especially developed for the analysis of High Temperature Reactors with spherical or prismatic fuel. A first version of the code has been written for accident analysis and solves the dynamics equations assuming constant xenon and samarium concentration in the reactor during the transient. A second version has been written for the investigation of the normal reactor operation neglecting delayed neutrons but treating xenon transients in detail. (auth)

6899 (EUR-5027) THERMAL INSULATING SYSTEM FOR GAS REACTOR CONCRETE PRESSURE VESSELS. Blanchard, G.; Crutzen, S.; Farfaletti-Casali, F. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 28 May 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25. EUR B.Fr. 40,-.

A general survey of thermal insulation system for prestressed-concrete pressure vessels and primary circuits as studied in the Technology Division of the Euratom Joint Research Center under the HTGR program is presented. The principal features are: systems particularly suited to be optimized in a helium atmosphere and structures completely prefabricated remarkable for its lightness. (auth)

6900 (RD/B/N-2639) ANALYSIS OF MEASUREMENTS OF RATING TILTS ACROSS AGR FUEL CLUSTERS. Bridge, M. J.; Howarth, N. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 39p. (RPC/RPNK/P-(73)39). Dep. NTIS (U.S. Sales Only) $4.00.

Calculations of cross-cluster rating gradients are compared with experimental determinations made in an AGR type reactor at Berkeley Nuclear Laboratories. The experiments covered the range of situations to be met in a power producing civil AGR, excluding irradiation effects. All calculations were carried out using the heterogeneous reactor code HET with dipole boundary coefficients (which control streaming) obtained from a FLOW collision probability calculation. Spectrum corrections were applied to few-group calculations by the DISPEC method and these spectrum corrected gradients agreed with multi-thermal energy group calculations to within a few % of the gradient. Overall, the best calculation predicts the gradients with a one standard deviation error of approximately 10%. Departures from the best calculation were investigated and it is concluded that: omission of spectrum corrections leads to errors of 10 to 20% and possibly as high as 40%; neglect of dipole-dipole interactions increases gradients by typically 5 to 10%, except adjacent to an interstitial rod where the increase may be 20%; a two energy group calculation underestimates gradients by 3 to 12% compared with a three group calculation. It is estimated that a two group HET/FLOW calculation with spectrum corrections but ignoring dipole-dipole interactions will predict CAGR cross-cluster gradients to within 20% at the start of life. (auth)

6901 THERMALLY SEVERE IRRADIATION TEST OF CANDIDATE HTGR RECYCLE FUELS. Olstad, R. A.; Fitts, R. B.; Olsen, A. R.; Long, E. L. Jr. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 221-223(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6902 MATRIX-PARTICLE INTERACTION IN HTGR FUEL RODS. Bradley, R. A.; Long, E. L. Jr. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 223(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6903 TWO-DIMENSIONAL COARSE NODAL DIFFUSION CALCULATION FOR THE HTGR. Steinke, R. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 230-232(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6904 PLUTONIUM UTILIZATION IN THE HTGR. Brogli, R. H.; Dahlberg, R. C.; George, C. H. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 298-299 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6905 TIMING THE USE OF RECYCLE FUEL IN THE HTGR. Homan, F. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 314-315(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6906 RUNNING-IN STRATEGIES FOR A LOW-ENRICHED HTGR WITH CONTINUOUS REFUELING. Hansen, U. (OECD Dragon Project, Dorchester, Eng.). Trans. Amer. Nucl. Soc.; 17: 316-317(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 6863, 7081, 7085, 7086, 7115, 7253, 7257, 7258, 7260, and 7275.

6907 (CONF-730414-P2, pp VIII.20-VIII.35) DIRECT DIGITAL CONTROL OF THE GENTILLY NUCLEAR POWER STATION. Cooper, W. R.; Whittall, W. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The main features of the control room are shown. A general view of the main control panel and the operator's console is presented. The CRT graphic display unit at the side of the operator's console and the CRT message displays and the fueling machine console are shown. The key part of the overall station control system is the control computer system, which consists of dual SEL 810A digital computers together with the peripheral equipment. Plant signals go to both computers in parallel. Either computer is capable of controlling, and the other is on standby. Each computer has a watchdog circuit that "times out" in two seconds unless it is held up by the successful completion of a set of self-check routines. If either computer detects a fault, its watchdog drops out, and this transfers control to the other computer. Transient faults result in one or more automatic restarts, provided this can be done before the watchdog drops. The programs are executed in both the operating and standby computers, but the outputs of the standby computer are inhibited. If both computer watchdogs drop, external logic shuts the plant down without invoking the protective system. The positive power coefficient is exploited, in this case, to achieve a rapid shutdown with a relatively small negative control reactivity. (auth)

6908 FREQUENCY RESPONSE MEASUREMENTS OF THE GENTILLY NUCLEAR REACTOR DYNAMICS. Serdula, K. J. (Atomic Energy of Canada, Ltd., Quebec); Kendall, J. D.; Cloutier, P. M.; Lawrence, C. B. pp 375-395 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The 250 MW(e) Gentilly Nuclear Power reactor is a departure from the CANDU pressurized heavy water coolant series (CANDU-PHWs) in that its coolant is boiling light water (CANDU-BLW). Retention of the concepts of maximum neutron economy and natural

uranium fueling have resulted in a system with a positive power coefficient. Because of this positive power coefficient and the prototypical nature of the station, a comprehensive program was planned to derive the controlled and uncontrolled frequency response functions of the neutron flux for reactivity perturbations in both the fundamental mode and the first azimuthal, or "tilt" mode. Problems caused by the necessity to operate within the limitations for normal station operation are discussed. The most restrictive constraint, the limited data storage capacity available for this application, necessitated digital filtering of data to overcome aliasing problems. Digitizing errors were a consideration for low power tests. The properties of the unique pseudorandom perturbation functions used and those of other excitation functions are discussed. (auth)

6909 HEAT TRANSFER IN DIRECT-CONTACT LIQUID FUEL REACTORS. Gat, U. (Univ. of Kentucky, Lexington); Green, R. A. Trans. Amer. Nucl. Soc.; 17: 429(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Power Reactors, Breeding

Refer also to abstracts 5041, 5432, 5435, 5457, 5524, 7017, 7021, 7059, 7064–7067, 7079, 7080, 7108–7112, 7130–7132, 7136–7139, 7141–7149, 7151–7155, 7190, 7252, 7256, 7266, 7280, and 7281.

6910 (CONF-730414-P1, pp II.130-II.133) FUEL CYCLE ANALYSIS WITH REPRESENTATIVE FLUX SOLUTIONS: FUMBLE CODE. Derby, S. L.; Cowan, C. L.; Greebler, P.; Hutchins, B. A. (General Electric Co., Sunnyvale, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Versatile and accurate fast reactor fuel cycle analysis, with reactor geometry in two or three dimensions, is available as a rapid, inexpensive computation with the representative flux solution method of FUMBLE. The approach removes the reactor eigenvalue computations from the internal numerical iteration. The accuracy and efficiency of the method are compared to direct calculation demonstrating its usefulness in solving fuel depletion problems for both equilibrium cycles and transition from startup to equilibrium for a somewhat simplified LMFBR model. It is planned to extend this approach to include control rod effects. 3 references. (auth)

6911 (CONF-730414-P2, pp VI.140-VI.161) FURTHER DEVELOPMENTS IN LMFBR OPTIMIZATION STUDIES AT EDF. Baby, J.; Guigou, J.; Lheureux, R.; Pasquet, J. P.; Rafalovitch, A.; Vergnes, J.; Vincent, F.; Zaleski, P. (Electricite de France, Paris). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The LMFBR optimization model study has been modified to include some aspects of components reliability, and to reduce computing time. In addition, complementary studies, such as the comparison between partial and overall plant optimization, and parametric and sensitivity studies, have been made. 7 references. (auth)

6912 (CONF-730414-P2, pp VII.187-VII.194) RESPONSE MATRIX ANALYSIS FOR FAST REACTORS. Bailey, H. S. (General Electric Co., Sunnyvale, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The highly heterogeneous core design typical of LMFBR's and the desire to predict both gross and local nuclear performance parameters accurately create a demand for reasonable cost neutronic calculational methods that will account for the geometric detail and neutron interactions in three dimensions. The response matrix approach that has been applied to thermal reactors has been extended and applied to LMFBR's using each hexagonal fuel assembly as a cell. Two-dimensional test case results for a bare core show good agreement of power distribution and reactivity with transport theory ($S4,P_0$). 8 references. (auth)

6913 (GEAP-13825-6) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS SIXTH QUARTERLY REPORT, APRIL–JUNE 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Jul 1973. 70p. Dep. NTIS $5.45.

Information on the development of LMFBR in-core instrumentation and in-vessel surveillance systems is presented concerning high-temperature neutron detectors and cable assemblies, acoustic monitoring systems, reactor core exit instrumentation, and an on-line reactivity computer system. (JWR)

6914 (KFK-1819) ASB71: DESCRIPTION OF THE TWO DIMENSIONAL BURNUP- AND MANAGEMENT-PROGRAM FOR FAST REACTORS. Stein, E. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1973. 107p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.

From the two-dimensional burnup and management program ASB, originating from INTERATOM, Bensberg, the considerably extended program ASB71 has been developed. A description of the physical and mathematical basis of the program, a description of the programming technique used, and detailed instructions for using the program ASB71 are presented. (auth)

6915 HTR IS BRIDGE TO BREEDER REACTOR. Energy Int.; 10: No. 10, 19-20(Oct 1973).

Gulf General Atomic's prototype high temperature reactor at Fort St. Vrain is undergoing pre-operational tests. High-temperature gas-cooled reactors using helium as the primary coolant will offer significant advantages as a primary source of electricity, useful in meeting applications in coal gasification, the recovery of bitumen from tar sands, and steel production. An explanation is given of the symbiosis between the GCFR and the HTGR. Several HTRs should be fuelled by the ^{233}U produced in the thorium blanket of a GCFR. The breeder is considered as a fuel factory, which, unlike the diffusion plant alternative, is capable of producing electricity as a by-product instead of consuming it. The breeder is uneconomic as a fuel producer alone but the value of the accompanying process heat or of electric power generated, makes a considerable contribution to the economics of the operation. (MCW)

6916 BOILING DETECTION IN THE 20- TO 50-kHz FREQUENCY RANGE. Dunn, M. J.; Ohanian, M. J. (Univ. of Florida, Gainesville). pp 545-555 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Coolant boiling in liquid metal-cooled fast breeder reactors and pressurized-water reactors is an abnormal operating condition which can lead to fuel-element failure with potentially serious safety and economic consequences. The objective of this study was to determine if nucleate boiling could be acoustically detected by observing the boiling noise spectrum above 10 kHz. The effects of pressure, coolant flow velocity and heat flux on the acoustical noise spectrum were also studied. Measurements were made in a cylindrical steel tank 20 in. in diam. by 37 in. high. The heated surface was a section of resistance heated zirconium fuel tube 0.406 in. i.d. by 0.415 in. o.d. by 1 in. long, assembled into an 18-in.-long tube mounted vertically in the tank. The acoustic probe was a ceramic crystal with flat response from 0.1 to 800 kHz, and a sensitivity of 0.49 V rms per lb/in^2. Measurements were made for all combinations of pressure (15, 30, 45, and 60 $lb/in.^2$ abs.) and coolant flow velocities (0, 5, 10, and 15 ft/s). The heat flux was varied from 1.5×10^5 to 1.0×10^6 $Btu/h\text{-}ft^2$ as required to attain various degrees of nucleate boiling. As expected, at constant pressure and flow velocity, increasing the heat flux increases the noise level. In all cases studied there was no measurable contribution to the signal above 20 kHz due to pump or cavitation noises. (auth)

6917 DEVELOPMENT OF THE IN-CORE NEUTRON DETECTORS FOR THE LMFBR. Mochizuki, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Matsuno, K.; Shirayama, S.; Sekiguchi, A.; Toraishi, A. pp 757-767 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Two types of in-core detectors suitable for LMFBR application have been developed. One is the miniature uncompensated ^{235}U fission chamber 10 mm × 100 mm with a 3.2-mm-dia. tri-axial mineral insulated cable. By using BeO as a chamber insulator and a triaxial cable as a guard ring, the leak current due to high

temperature is decreased. The other type is the self-powered detector of 3.4-mm-dia. × 100-mm long with two emitters that have an almost similar atomic number and density, but the neutron activation cross-sections differ considerably; thus the noise background caused by gamma rays is reduced to one-tenth or less by subtracting two output currents. (auth)

6918 PERFORMANCE OF A PROCESS GAS CHROMATOGRAPH ANALYZING SODIUM COVER GAS. Barton, G. B. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 159(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6919 FLOW PATTERNS IN SODIUM COLD-TRAP CRYSTALLIZERS. Lester, D. H. (Battelle Memorial Inst., Richland, WA); Bloom, G. R. Trans. Amer. Nucl. Soc.; 17: 163-164(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6920 TRANSPORT OF ACTIVATED CORROSION PRODUCTS IN SODIUM LOOPS. Colburn, R. P. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 17: 165(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6921 SHORT-TERM RESTRUCTURING AND DENSIFICATION IN MIXED-OXIDE FUEL ELEMENTS. Lambert, J. D. B.; Neimark, L. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 170-172(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6922 FUEL STACK DIMENSIONAL VARIATIONS IN FAST REACTOR PINS UNDER IRRADIATION. Calza Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U.; Rotoloni, P. L. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 17: 172-173 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6923 POWER CYCLING EFFECTS ON FUEL PIN CENTER TEMPERATURE. Lawrence, L. A. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 173-174 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6924 MODELING OF THE FUEL CLADDING POSTIRRADIATION GAP IN MIXED-OXIDE FUEL PINS. Dutt, D. S.; Baker, R. B.; Chastain, S. A. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 175(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6925 YY02 INSTRUMENTED IRRADIATION OF LMFBR ABSORBER MATERIAL. Pitner, A. L. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 188-189 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6926 OPERATING CHARACTERISTICS OF LINEAR-MOTION SODIUM FREEZE-SEAL VALVE. Misra, B.; Folkrod, J. R.; Rohde, R. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 189-190(Nov 1973).
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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6929 EXAMINATION OF HIGH BURNUP EXPERIMENTAL FUEL ASSEMBLIES IRRADIATED IN EBR-II. Hilbert, R. F. (General Electric Co., San Jose, CA); Black, T. J.; Cantley, D. A.; Kaplan, S.; Punches, J. R.; Hayner, G. O. Trans. Amer. Nucl. Soc.; 17: 213-214(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6930 BEHAVIOR OF VOLATILE FISSION PRODUCTS IN GCFR FAST FLUX IRRADIATIONS. Langer, S. (Gulf General Atomic Co., San Diego, CA); Lindgren, J. R.; Hayner, G.; Bono, R. Trans. Amer. Nucl. Soc.; 17: 219-220(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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6933 REDUCTION OF MESH DISTORTION IN 2-D LAGRANGIAN CODES BY THE USE OF MESH REGULARIZING MECHANISM. Chang, Y. W.; Guildys, J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 245-246(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6934 IMPROVED VISCOUS PRESSURE FORMULATION FOR TWO-PHASE COMPRESSIBLE HYDRODYNAMICS CALCULATIONS. Wider, H. U. (Argonne National Lab., IL); Jackson, J. F.; Eggen, D. T. Trans. Amer. Nucl. Soc.; 17: 246(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6935 ECONOMIC CHARACTERIZATION OF BREEDER REACTOR BLANKET PERFORMANCE. Wood, P. J.; Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 17: 313(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6936 ECONOMICS OF THORIUM BLANKETS FOR FAST BREEDER REACTORS. Wood, P. J.; Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 17: 314(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6937 THEORETICAL AND EXPERIMENTAL STUDY OF PHENIX STEAM GENERATOR PROTOTYPE MODULES. Duchatelle, L.; De Nucheze, L.; Robin, M. G. (CEN, Saclay, France). Trans. Amer. Nucl. Soc.; 17: 381-382(Nov 1973).
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6939 FAST REACTOR OPTIMIZATION. Christic, A. M. (Basic Technology, Inc., Pittsburgh); Poncelet, C. G. Trans. Amer. Nucl. Soc.; 17: 385(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6940 EVALUATION OF LMFBR CORE RESTRAINT SYSTEMS USING A PLANAR MOCKUP. Magee, P. M.; Meserve, C. E. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 394(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6941 NUBOW: A NEW COMPUTER PROGRAM FOR ANALYZING BOWED REACTOR CORES. McLennan, G. A.; Huebotter, P. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 394-395(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6942 APPLICATION OF DAMAGE FRACTION RULES IN ASSESSING CLADDING INTEGRITY. Sim, R. G.; Vaidyanathan, S.; Meinhardt, W. G. (General Electric Corp., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 396-397(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6943 EFFECT OF CIRCUMFERENTIAL CLADDING TEMPERATURE VARIATIONS ON THE OVERALL FUEL-TO-CLADDING MECHANICAL INTERACTION UNDER STEADY-STATE CONDITIONS. Vaidyanathan, S.; Sim, R. G. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 398-399 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6944 11:1-SCALE MODEL ROD BUNDLE AIR FLOW TESTS: GRIDDED ROD BUNDLE FLOW-RATE AND PRESSURE-DROP STUDIES. Pechersky, M. J. (Westinghouse Electric Corp., Madison, PA); Roidt, R. M.; Markley, R. A.; Vegter, B. J. Trans. Amer. Nucl. Soc.; 17: 414-415(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6945 LMFBR PROBLEMS DUE TO LARGE TEMPERATURE DIFFERENCES. Bump, T. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 421-422(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6946 PEFT-II: A TOOL FOR CORE-WIDE PROBABILISTIC ANALYSIS OF LMFBR FUEL THERMAL PERFORMANCE. Temme, M. I.; Atcheson, D. B. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 423(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6947 ANALYTICAL TECHNIQUES FOR THERMAL/HYDRAULIC DESIGN OF LMFBR ASSEMBLIES. Carelli, M. D.; Bach, C. W.; Markley, R. A. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 17: 423-424(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6948 SINGLE-ELEMENT MODEL OF THERMAL-HYDRAULIC BEHAVIOR FOR AN LMFBR SUBASSEMBLY. Miles, K. J.; Fazzolare, R. A. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 17: 424-425(Nov 1973).
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6949 TEMPERATURE MAPPING OF A TYPICAL 217-PIN LMFBR FUEL ASSEMBLY. Sha, W. T.; Schmitt, R. C.; Huebotter, P. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 425-426(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6950 DETAILED THERMAL PERFORMANCE IN THE GCFR FUEL ELEMENT. Hopkins, H. C. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 17: 428-429(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6951 ANALYSIS OF FAST-NEUTRON TRANSPORT IN TWO-REGION SYSTEMS. Gibbs, D. C.; Malaviya, B. K.; Kaushal, N. N. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 17: 470-471(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6952 HETEROGENEOUS EFFECTS ON REACTIVITY OF FAST BREEDER REACTORS. Gregory, M. V.; Driscoll, M. J.; Lanning, D. D. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 17: 471-472(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6953 FUELS AND MATERIALS FAST REACTOR DOSIMETRY DATA DEVELOPMENT AND TESTING. McElroy, W. N. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 515-516(Nov 1973).
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6954 PREPARATION AND CHARACTERIZATION OF NEUTRON DOSIMETER MATERIALS. Kobisk, E. H.; Adair, H. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 516(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6955 MEASUREMENT OF ABSOLUTE FISSION RATES. Grundl, J. A. (National Bureau of Standards, Washington, DC); Dudey, N. D.; Popek, R. J. Trans. Amer. Nucl. Soc.; 17: 516-517(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6956 NON-FISSION REACTION RATE MEASUREMENTS. Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID); Helmer, R. G.; Rogers, J. W.; Dudey, N. D.; Popek, R. J.; Kellogg, L. S.; Zimmer, W. H. Trans. Amer. Nucl. Soc.; 17: 517-518(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6957 HIGH FLUX LEVEL REACTION RATE MEASUREMENTS. Zimmer, W. H. (Atlantic Richfield Hanford Co., Richland, WA); Heinrich, R. R.; Kellogg, L. S.; Matsumoto, W. Y. Trans. Amer. Nucl. Soc.; 17: 518(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6958 FISSION PRODUCT RATE MEASUREMENTS AND YIELDS. Dudey, N. D. (Argonne National Lab., IL); Popek, R. J.; Greenwood, R. C.; Helmer, R. G.; Rogers, J. W.; Kellogg, L. S.; Zimmer, W. H. Trans. Amer. Nucl. Soc.; 17: 518-519 (Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6959 ENDF/B FILE FOR DOSIMETRY APPLICATIONS. Magurno, B. A.; Ozer, O. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 17: 528-529(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Research, Test, and Experimental Reactors

Refer also to abstracts 5214, 6925–6927, 7079, 7125–7129, 7150, 7166, 7197, 7199, 7259, 7261, 7272, 7275, and 7277–7279.

6960 (AEEW-R-888) ZEBRA 8H: A $^{235}U/^{238}U$ FAST REACTOR BENCHMARK. Burbidge, B. H.; Ingram, G.; Jowitt, D.; Sanders, J. E. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jul 1973. 46p. Dep. NTIS (U.S. Sales Only) $4.50.

Measurements of k-infinity and reaction rate ratios have been made in a simple zero-leakage test region assembled in Zebra from plates of enriched and natural uranium metal. A detailed account of the experimental techniques is given. The results are compared with calculations using the FGL4 and FGL5 cross-section sets. The limiting critical enrichment of homogeneous uranium and its spectral indices are derived. (auth)

6961 (ANCR-1107) COMPUTER PREDICTED OUTER SHIM POSITIONS FOR CRITICALITY IN THE ADVANCED TEST REACTOR. Bingham, D. R.; Napper, P. R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Aug 1973. Contract AT(10-1)-1375. 94p. Dep. NTIS $5.45.

The computer program was developed to predict accurately outer shim positions for criticality in the ATR using a previously irradiated core. This program which uses a 480-point calculative technique performs somewhat better than the previous program which used a five-point calculative technique. In addition to providing better shim predictions for criticality, this program supplies the user with the greater assortment of useful information. With this program it is now possible to obtain predictions involving mixed fuel loadings (partially expended fuel elements from several cycles). Considerable effort was devoted to simplify the input to this program in order to reduce the amount of data preparation for input. (auth)

6962 (CONF-730414-P1, pp II.134-II.143) DEVELOPMENT AND USE OF A DATA FILE FOR FREQUENTLY CHANGING HETEROGENEOUS REACTOR CONFIGURATIONS. Walker, P.; Meneghetti, D.; Sullivan, J. E. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

EBR-II (Experimental Breeder Reactor No. 2) was originally designed and operated to provide a small plant demonstration of a sodium-cooled fast breeder reactor. Following the successful demonstration of the reactor, the need for an adequate fast reactor irradiation test and examination facility led to its operation for the testing of fast reactor fuel, structural, and poison materials. It is important to have reliable data on the compositional environment of the reactor to facilitate the management of the fuel and the experimental subassemblies. These data can best be obtained by calculating the actual loadings from the beginning of the reactor lifetime and the changes in atom densities. It is also desirable that data be available corresponding to any reactor run made in the past. 5 references. (auth)

6963 (COO-3409-2) BREAZEALE NUCLEAR REACTOR. Eighteenth Annual Progress Report, July 1, 1972–June 30, 1973. Levine, S. H.; Robinson, G. E. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Jun 1973. Contract AT(11-1)-3409. 80p. Dep. NTIS $6.00.

Research programs, training and educational activities, and operations aspects for the Penn State Breazeale Reactor during July 1, 1972 to June 30, 1973 are reviewed. Personnel and administrative activities for the reactor facility are described. (DCC)

6964 (GKSS-72/E/34) NOISE ANALYSIS AND PSEUDO-STOCHASTIC PERTURBATION TECHNIQUES FOR REACTOR PARAMETER ESTIMATION. Kolb, M.; Raschti, M. A.; Robinson, E.; Weber, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F.R. Germany)). 1972. 19p. (CONF-730108-13; SM-168/C-2). Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

Measurements of the reactivity-power transfer function which were carried out on the FRG-1 and FDR are described. The reactivity balance of the nuclear reactors are disturbed by moving the control rod in pseudostochastic binary manner. The autopower and cross-power spectral densities and the transfer functions are measured by correlation techniques. Comparing the dynamic models of the reactors with the measured data (least square fits), reactivity coefficients are calculated. (GE)

6965 (HEDL-TME-73-4(Vol. 3)) HEDL QUARTERLY TECHNICAL REPORT, APRIL–JUNE 1973. Volume 3. Engineering and Development. Noordhoff, B. H.; Weber, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-2170. 88p. AT.

The testing of FFTF components and systems is described. Core mockup programs are reviewed. The development and testing activities for reactor instrumentation are described. The fabrication of reactor components and construction of the FFTF are summarized. (DCC)

6966 (LMEC-TDR-73-10) MODEL TEST OF TIME RESPONSE OF LARGE PERMANENT MAGNET FLOWMETERS. Baker, R. S.; Griffin, C. W.; Schiowitz, H. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1 Oct 1973. Contract AT(04-3)-700. 46p. Dep. NTIS $4.50.

The results of a limited, low-cost effort to determine the transient response of a large permanent magnet flowmeter in support of the FFTF project are presented. Two different test methods were used to determine the response of a simulated 12-in.-diameter permanent magnet flowmeter. The first method consisted of oscillating a 12-in.-diameter aluminum cylinder in a magnetic field by the use of an electromagnetic vibration tester. Because of the limited frequency span of the vibration tester and the noise and distortion imposed on the sinusoidal waveshape by the tester, data from the oscillatory tests did not precisely define the time constant. Using a single lag assumption, the break frequency for the 12-in.-diameter simulated flowmeter could be placed between 13 and 18 Hz. This corresponds to a time constant between 12 and 8 msec, which is close to the value predicted by theoretical expectations. The second test method consisted of dropping the 12-in.-diameter aluminum cylinder in a magnetic field and observing the electrical voltage generated during the period of motion. Because of the short magnetic field length, analysis of the drop test data, by itself, was also not conclusive, but indicated a time constant between 10 and 40 msec, thus tending to corroborate the results from the oscillatory testing. The electrical conductivity, and therefore the time constant, for sodium at 750°F is about a factor of one-sixth that of aluminum at room temperature. Thus, for 750°F sodium, the correlative time constant is calculated to be between 0.001 and 0.002 sec from the oscillation tests versus 0.002 and 0.007 sec for the drop tests. (auth)

6967 (T-743) TRIGA OWNERS' CONFERENCE, PAVIA, ITALY, SEPTEMBER 13–15, 1972. Papers and Abstracts. (Gulf Energy and Environmental Systems, Inc., San Diego, Calif.). 1972. 376p. (CONF-720993-).

Information on TRIGA reactors is presented concerning experience in operation and maintenance, research programs, and technology development. Separate abstracts are included for 25 of the 26 papers presented. One paper has been previously abstracted and included in NSA, Vol. 28, abstract 14481. (DCC)

For abstracts of individual papers see: 4798, 4838, 4934, 5037, 6574, 6968–6986, and 7272.

6968 (T-743, pp 1.1-1.13) ROLE OF TRIGA REACTORS IN PURE AND APPLIED NUCLEAR RESEARCH OUTSIDE THE UNITED STATES IN THE LAST COUPLE OF YEARS. Rollier, M. A. (Univ., Pavia, Italy). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Information is presented concerning the trend of research in European TRIGA reactors, new TRIGA reactors in Europe during 1971 and 1972, research at TRIGA reactors and new TRIGA reactors outside Europe and U. S., and safety aspects of TRIGA reactors. (25 references) (DCC)

6969 (T-743, pp 2.1-2.7) EXPERIENCE IN OPERATION AND MAINTENANCE INCLUDING ANOMALOUS OPERATION. Anttila, K. (State Inst. for Technical Research, Helsinki). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6970 (T-743, pp 2.8-2.18) EXPERIENCE IN OPERATION AND MAINTENANCE OF THE TRIGA MAINZ REACTOR. Menke, H. (Univ., Mainz). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Operations, maintenance requirements, and reactor modifications during 1967 to 1971 are reviewed. (DCC)

6971 (T-743, pp 2.69-2.80) TRENDS IN THE OPERATION OF THE LENA 250 kW TRIGA MARK II REACTOR. Meloni, S.; Cambieri, A.; Cingoli, F.; Genova, N. (Univ., Pavia, Italy). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6972 (T-743, pp 2.81-2.87) OPERATION, MAINTENANCE, AND UTILIZATION OF THE 250-kW TRIGA MARK II REACTOR. Dimic, V.; Gabrovsek, Z. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6973 (T-743, pp 2.88-2.92) USE OF A PROGRAMMABLE DESK CALCULATOR TO ACHIEVE FAST, ACCURATE CONTROL ROD CALIBRATION. Randall, J. D.; Naugle, N. W. (Texas A and M Univ., College Station). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

In the development of a least squares calculator program for the rapid calibration of control rods at the NSCR at Texas A&M University it was necessary to verify that all rods, with the exception of the transient rod, could be accurately defined by a single analytical expression. Since the vertical flux distribution in the core region follows a cosine function, a cosine squared variation was tested. The differential rod worths for nine different calibrations of the three shim-safeties and the regulating rod were normalized to their maximum value and the location of the maximum value was shifted to the nominal control rod midpoint which is 20 cm. By trial and error a value of the argument for the cosine function was found. (auth)

6974 (T-743, pp 2.93-2.103) DYNAMICAL REACTIVITY MEASUREMENTS. Strube, D. (Association for Radiation Research, Munich). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

A computer program is presented for calculating the reactivity worth of control rods. Procedures for measuring the reactivity worth of FRN Reactor control rods are described. (DCC)

6975 (T-743, pp 2.111-2.131) NEW COOLING SYSTEM OF THE IPR-R1 REACTOR. Andrade, V. M. (Univ. Minas Gerais, Belo Horizonte, Brazil). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

A 250 kW cooling system was designed and installed to cool the demineralized water of the IPR-R1 reactor (Triga Mark I). The primary circuit is made of 304 stainless steel. The secondary circuit is made of carbon steel, and the cooling tower of fiberglass. The heat exchanger is of the shell-and-tube type with four tube passes. The demineralized water (primary side) flows through the shell and the ordinary water flows inside the tubes. This arrangement allows cleaning of the tubes (straight tubes) by simply disassembling the top of the heat exchanger. The cooling system was designed to operate at a pool temperature of 40.7°C. Cold water returns to the reactor tank in summer days at a maximum temperature of 33.1°C. The water flow in the primary side can be varied from 28 m^3/h to 32 m^3/h. Interlocks and protection devices coupled to pressure gauges, temperature and water level meters provide a very safe and reliable performance to the cooling system. (4 references) (auth)

6976 (T-743, pp 2.132-2.144) REACTOR OPERATION EXPERIENCE. Boeck, H. (Federal Ministry of Education, Vienna). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The operating experience and research programs for the TRIGA-2-Vienna reactor are reviewed. (DCC)

6977 (T-743, pp 3.1-3.26) SURVEY OF RECENT APPLICATIONS OF TRIGA RESEARCH REACTORS. Chesworth, R. H. (Gulf Energy and Environmental Systems, San Diego, CA). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Applications of TRIGA reactors are discussed for areas of nondestructive testing, medical applications, activation analysis, and special testing. (7 references) (auth)

6978 (T-743, pp 3.27-3.42) STUDY OF IRRADIATION EFFECTS ON IN-CORE INSTRUMENTATION. Angelino, G. (CISE, Milan). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The knowledge of in-core instrumentation performance is a very important item when irradiations of technological interest are concerned. When measurement of small changes in mechanical or thermal properties is of major importance, the effect of neutron and gamma irradiation on various transducers must be thoroughly evaluated. A rig mock-up was irradiated in the Triga Mark II Reactor of the Pavia University to assess the possibility of carrying out a study on irradiation effects on in-core instrumentation. Data on neutron flux distribution and γ-heating effect were collected from this preliminary experiment; at the same time a complete check was performed on rig assembling procedure, on the behavior under operating conditions, and on the reactor loading and unloading operations. (auth)

6979 (T-743, pp 3.43-3.48) USE OF THE TRIGA REACTOR FOR THE STUDY OF NEUTRON PULSES EFFECT ON SEMICONDUCTORS. Di Giorgio, A.; Gallo, G. (CAMEN, Pisa, Italy). 1972. (In Italian).

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6980 (T-743, pp 3.100-3.108) SEED IRRADIATION FACILITIES AT TRIGA MARK II REACTOR. Najzer, M. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6981 (T-743, pp 3.109-3.114) RESEARCH IN THE FIELDS OF RADIOCHEMISTRY AND ACTIVATION ANALYSIS USING THE LENA TRIGA NUCLEAR PLANT. Maxia, V.; Meloni, S.; Stella, R.; Brandone, A. (Univ., Pavia, Italy). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

6982 (T-743, pp 3.132-3.142) USE AND CONSTRUCTION OF NEW FACILITIES. Anttila, K. (State Inst. for Technical Research, Helsinki). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

Design parameters for new and modified experimental facilities of the FIR-1 reactor are presented. (DCC)

6983 (T-743, pp 3.149-3.154) CURRENT RESEARCH WORK CARRIED OUT AT THE 250 kW TRIGA MARK II REACTOR. Dimic, V.; Kristof, E.; Rant, J. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The physics experiments involving cold neutron, fast neutron, and n-gamma spectrometry are described. (auth)

6984 (T-743, pp 4.1-4.32) STARTUP OF TORREY PINES MARK III AND PUERTO RICO NUCLEAR CENTER REACTORS WITH TRIGA-FLIP FUEL. Chesworth, R. H. (Gulf Energy and Environmental Systems, San Diego, CA). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The design characteristics are presented for TRIGA-FLIP cores in two different geometries: the normal TRIGA single-rod geometry; and the four-rod cluster geometry. The fuel is 8.5 wt % uranium, 70% enriched ^{235}U. The hydrogen-to-zirconium atom ratio is 1.5 to 1.65 and the cladding material is stainless steel. The basic neutronic characteristics of the fuel in both reactor installations are described. (auth)

6985 (T-743, pp 4.33-4.46) TRIGA REACTOR FRANKFURT CONSTRUCTION AND EXPERIMENTAL FACILITIES. Rossberg, D.; Wensel, A.; Wolf, G. (Univ., Frankfurt am Main). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The maximum power level of the FRF-2 reactor will be 1 MW. Performance and design data for the reactor are presented. (auth)

6986 (T-743, pp 4.47-4.54) STANDARD IRRADIATION FACILITIES FOR USE IN TRIGA REACTORS. Kolbasov, B. N.; Luse, R. A. (IAEA, Vienna). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The development of a standard neutron irradiation facility (SNIF) to be used in TRIGA reactors for radiobiological studies is described. (9 references) (auth)

6987 (TID-26474) CLEM COLD WALL EMISSIVITY TESTS. Final Report (30, 60, 100 Day 700°F Sodium Soak). Horton, P. H. (Atomics International, Canoga Park, Calif. (USA)). 22 Jun 1972. 88p. (TR-681-414-2). Dep. NTIS $6.50.

Final test results are presented for the CLEM Cold Wall Emissivity Test. Pre-test and post-test emissivity values are given for the 30, 60 and 100 day sodium soak test coupon for both the vendor applied "Black Chrome" and AI applied "Wet H_2" coatings. Also included are results of post-test coating adherence (bend and peel) tests. Emissivities of both coatings were generally uneffected by the sodium soak, emissivities remained approximately 78% to 85%, however all coatings were wetted by the sodium. The "Black Chrome" coupons were cleaned of sodium by heating to slightly less than 400°F while sodium remained on the "Wet H_2" coupons to the 700°F–900°F region. Coating adherence was good on both coupon types and either appears equally good for the CLEM Cold Wall coating. The "Black Chrome" coating may be more desirable because of the "cleanup" of the wetted sodium at a lower temperature. (auth)

6988 CORRELATION MEASUREMENTS AT THE WWR-SM REACTOR. Pallagi, D.; Horanyi, S. (Central Research Inst. for Physics, Budapest). pp 649-658 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

During recent years reactor noise measurements were made at the 5-MW research reactor in Budapest. Efforts were centered on the out-of-core detection of bulk-boiling and the in-core coolant flow-rate determination with the aid of correlation methods. Digital correlators were developed and used as basic instrumentation for these applications. A short review is given on temperature and neutron flux fluctuation measurements. Instrumental basis, computation methods as well as the results, are discussed. (auth)

6989 UNDERWATER HANDLING AND EXAMINATION OF EXPERIMENTAL FUEL FROM THE NRU RESEARCH REACTOR AT CHALK RIVER. Christie, J.; Herbert, L. N.; Mizzan, E. (Atomic Energy of Canada Ltd., Chalk River). Conf. Remote Syst. Technol., Proc.; No. 21, 53-61(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

At Chalk River Nuclear Laboratories, recent developments in underwater fuel handling and examination techniques associated with irradiation testing of experimental fuels have led to less delay time between removal from the reactor and fuel inspection, flexibility and diversity in testing, simple and safe operations. These advances were achieved by utilization of a wet transfer can to transport fuel between the reactor and the inspection bays; a carriage to support fuel bundles; improved fuel handling tools, underwater lights, and viewing equipment; a quick, reliable, leak detection method; and a demountable element bundle in which any of the 16 elements in the outer ring can be replaced underwater in only a few minutes. (auth)

6990 POSTIRRADIATION HANDLING OF IN-CORE INSTRUMENT TEST FACILITY (INCOT) COMPONENTS IN THE EBR-II REACTOR BUILDING. Divona, C. J. (Argonne National Lab., IL). Conf. Remote Syst. Technol., Proc.; No. 21, 62-69(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

Equipment and techniques have been developed for handling irradiated In-Core Instrument Test Facility (INCOT) components in the EBR-II reactor building. On removal from the reactor, these long (~30 ft), slender, sodium-covered components are transferred to an inerted storage facility within the reactor building. A borescope inspection system, a heating facility, and various cutting devices are employed for inspection, handling, and disposal of the components. (auth)

6991 POWER PULSE FLUCTUATIONS OF A PERIODICALLY PULSED FAST REACTOR. Schwalm, D. (EURATOM, Ispra, Italy). Nucl. Sci. Eng.; 52: No. 2, 267-274(Oct 1973).

The variances of pulse fluctuations of a periodically pulsed fast reactor have been calculated. The characteristic parameters of SORA, the 1-MW pulsed fast reactor, under development by Euratom at Ispra, have been used as input data. As a result, the relative standard deviation was found to be independent of the duration of the power pulse and the pulse shape and inverse proportional to the square root of the operation power. (auth)

6992 PROTOTYPE APPLICATIONS LOOP CHARACTERIZATION SYSTEM: A COMPARISON OF METHODS FOR OXYGEN IN SODIUM. McCown, J. J. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 159-160(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6993 ENVIRONMENTAL INSTRUMENTED SUBASSEMBLY FOR EBR-II. Gillette, J. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 180(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6994 INCREASING THE CENTRAL POWER IN EBR-II. Miller, L. B. (Argonne National Lab., IL); Jarka, R. E.; Gillette, J. L.; Kirn, F. S. Trans. Amer. Nucl. Soc.; 17: 180-181(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6995 LOW FRICTION MATERIALS FOR WEAR APPLICATIONS IN THE FFTF. Johnson, R. N.; Marchbanks, M. F.; Irvin, J. E. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 185(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6996 TAG-GAS CAPSULE FILLING OPERATIONS USING A LASER. Bradley, J. G. (Westinghouse Electric Corp., Richland, WA); Gordon, R. L. Trans. Amer. Nucl. Soc.; 17: 186-187(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6997 ENGINEERING SCALE TESTS OF AN FFTF FISSION GAS DELAY BED. Kabele, T. J. (Westinghouse Electric Corp., Richland, WA); McElroy, J. L. Trans. Amer. Nucl. Soc.; 17: 189(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6998 ANALYSIS OF INTERFERENCE STRESSES IN EBR-II SUBASSEMBLIES. Chopra, P. S.; Honekamp, J. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 212-213(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

6999 TEXTURE STUDIES ON EBR-II, MARK-II DRIVER FUEL. Walters, L. C.; Hofman, G. L.; Rohde, R. H. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 217-218(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7000 END-OF-LIFE OBSERVATIONS ON MARK-IA DRIVER FUEL ELEMENTS IRRADIATED IN EBR-II. Olson, N. J. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 218-219(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7001 LOSS-OF-FLOW SIMULATIONS WITH PRE-IRRADIATED FFTF TYPE FUEL PINS (TESTS L3 AND L4). Barts, E. W. (Argonne National Lab., IL); Deitrich, L. W.; DeVolpi, A.; Eberhart, J. G.; Fischer, A. K.; Froehle, P. H.; Murphy, W. F.; Stahl, D.; Stewart, R. R.; Tylka, J. P.; Harrison, L. J. Trans. Amer. Nucl. Soc.; 17: 363(Nov 1973).

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Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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7014 DIGITAL ON-LINE REACTIVITY ANALYSIS SYSTEM. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, TN); Mott, J. E.; Churchich, M.; Mathis, M. V.; Robinson, J. C.; Ackermann, N. J. Jr. Trans. Amer. Nucl. Soc.; 17: 445-446(Nov 1973).
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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7016 DUAL-CORE URANIUM-ZIRCONIUM HYDRIDE RESEARCH REACTOR FOR TESTING POWER REACTOR FUEL. Iftode, I. (Inst. for Nuclear Tech., Bucharest); Chesworth, R. H. Trans. Amer. Nucl. Soc.; 17: 450-451(Nov 1973).
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Travelli, A.; Beitel, J. C. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 465-466(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7025 DEVELOPMENTS IN HIGH-ENERGY NEUTRON SPECTROSCOPY. Reynolds, R. S. (Mississippi State Univ., Mississippi State); Simons, G. G.; Larson, J. M. Trans. Amer. Nucl. Soc.; 17: 466-467(Nov 1973).
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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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7029 ^{235}U COMPACT Cu-REFLECTED TAPIRO REACTOR INTEGRAL EXPERIMENT RESULTS AND A CHECK OF SOME HIGH-ENERGY ENDF/B-III DATA. D'Angelo, A. (Univ., Calabria, Italy); Martini, M.; Salvatores, M. Trans. Amer. Nucl. Soc.; 17: 498-499(Nov 1973).
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7030 UNDERWATER HANDLING AND EXAMINATION OF EXPERIMENTAL FUEL FROM THE NRU RESEARCH REACTOR AT CHALK RIVER. Christie, J.; Herbert, L. N.; Mizzan, E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 17: 511-512(Nov 1973).
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7038 CHARACTERISTICS OF A PULSED FAST-NEUTRON-TO-GAMMA-RAY CONVERTER. Kazi, A. H.; Harrison, R. C.; Williams, D. O. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Trans. Amer. Nucl. Soc.; 17: 556(Nov 1973).
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7039 CALCULATION OF PENETRATIONS IN THE FTR RADIAL CAVITY SHIELD. Emmett, M. B.; Engle, W. R. Jr.; Mynatt, F. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 561-562(Nov 1973).
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Production and Materials Testing and Processing Reactors

Refer also to abstracts 6988, 7056, and 7160.

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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7042 DEVELOPMENT OF HIGH-PERFORMANCE URANIUM METAL FUELS FOR SAVANNAH RIVER REACTORS. McDonell, W. R.; Sturcken, E. F. (E. I. duPont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 155-157(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7043 HISTORY OF DEVELOPMENT OF FUEL ELEMENTS FOR MTR. Cunningham, J. E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 158(Nov 1973).
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Propulsion and Package Reactors

Refer also to abstracts 5398-5401, 6964, 7089, 7090, 7135, and 7235.

7044 (AI-AEC-13070) SNAP 8 SUMMARY REPORT. (Atomics International Div., Canoga Park, Calif. (USA)). 24 Sep 1973. Contract AT(04-3)-701. 194p. Dep. NTIS $11.75.

The SNAP 8 Program was directed toward the development of lightweight nuclear reactors which would operate in space for greater than 10,000 hr at a power level of 600 kW(t). Toward this objective, two reactors were designed, built, and successfully operated. The experimental reactor (S8ER) was an engineering test of a prototype core, but did not have flight-developed hardware. The developmental reactor (S8DR) was a nuclear system test to verify the operability of the integrated flight configuration. The development, design characteristics, operating experience, experimental results, and supporting tests for the S8ER and S8DR are discussed. 20 references. (auth)

7045 (ANL-7031) NUCLEAR ROCKET PROGRAM METALLURGY DIVISION PROGRESS REPORT FOR QUARTER ENDING DECEMBER 31, 1964. (Argonne National Lab., Ill. (USA)). Apr 1965. Contract W-31-109-eng-38. 124p. Dep. NTIS $8.25.

Declassified 2 Aug 1973.

Work is reported in the following areas: development and fabrication of high-temperature cermets (W–UO_2); stabilization of UO_2 (addition of Dy_2O_3, Gd_2O_3, CaO, Sm_2O_3, ThO_2, ZrO_2, or Eu_2O_3); development of thin tungsten tubing; cladding of cermet fuels; properties (Young's modulus of W and W–25 wt% Re, thermal expansion of W–UO_2 cermet); evaluation of cermets (stabilized and unstabilized); nondestructive testing of reactor components; and irradiation testing of cermet fuels. (DLC)

7046 (JUL-960-TP) IRRADIATION EXPERIMENTS WITH THERMIONIC FUELS IN THE KERNFORSCHUNGSANLAGE JUELICH. Herlon, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Technische Physik). Jun 1973. 48p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

Within the framework of the ITR project, two irradiation experiments have been carried out with thermionic fuel elements (triple diodes). Irradiation times of 1,545 and 1,466 hours were obtained with an average capacity of 32 W/cm^2 of emitting surface. Following a brief description of the experimental equipment, the essential parameters and the current-voltage curve in the second experiment are presented. The equipments had to be interrupted for safety reasons as [illegible] occurred in the fission gas chambers. (GE)

7047 (PWAC-398(Pt. 1)(Vol. 1)) LCRE ENGINEERING REPORT: DESIGN. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 10 Apr 1964. Contract AT(30-1)-2789. 362p. Dep. NTIS $20.25.

Declassified 5 Sep 1973.

Engineering design work on the lithium-cooled reactor experiment is described. The work included the reactor, heat removal system, and auxiliary systems. (JMR)

7048 (WANL-TME-1200) NERVA II REACTOR DESIGN EVALUATIONS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1965. 208p. Dep. NTIS $12.50.

Declassified 30 Aug 1973.

Reported are the results of an investigation into proposed structural approaches to a 5000 MW NERVA II reactor. This work is an extension of an earlier study reported in WANL-TME-978, Preliminary Study of the NERVA II Reactor Design. As a result of this investigation, it is now possible to recommend a combined structural approach which eliminates the inner reflector cylinder and provides improved alternate periphery configurations. Other approaches considered were the aluminum lateral support cylinder and the graphite stave lateral support cylinder. Major areas of study were the tie tube and axial support system, the core periphery and lateral support system, the outer reflector and control drums, and the radiation shield. (auth)

7049 ASSESSMENT OF LIGHTWEIGHT MOBILE NUCLEAR POWER SYSTEMS. Anderson, J. L.; Rom, F. E. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 17: 6(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7050 COLLOID CORE REACTOR ROCKET ENGINE CONCEPT. Black, D. L.; Kyslinger, J. A.; Ravets, J. M. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 6-7(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7051 EMISSION COEFFICIENT INVESTIGATION OF URANIUM PLASMAS. Mack, J. M. (Martin-Marietta Corp., Orlando, FL); Schneider, R. T.; Campbell, H. D. Trans. Amer. Nucl. Soc.; 17: 7-8(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7052 PRODUCTION OF A FISSIONING URANIUM PLASMA. Hohl, F. (Langley Research Center, Hampton, VA); Lee, J. H.; Kim, K. H.; McFarland, D. R. Trans. Amer. Nucl. Soc.; 17: 8-9 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7053 TIME-DEPENDENT INTERSTITIAL DIFFUSION IN A TEMPERATURE GRADIENT. Lee, C. E.; Wallace, T. C. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 257-258(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7054 TECHNIQUE TO DETERMINE THE SHAPE OF A MINIMUM WEIGHT SHIELD. Engle, W. W. Jr.; Mynatt, F. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 556-557 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7055 CNSG-NUCLEAR SHIP DEEP-PENETRATION BIOLOGICAL DOSE RATE ANALYSIS. Anderson, F. N. (Babcock and Wilcox Co., Lynchburg, VA); Sapyta, J. J.; Simmons, G. L. Trans. Amer. Nucl. Soc.; 17: 562-564(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Reactor Safety and Environmental Aspects

Refer also to abstracts 5097, 5102, 5108, 5145, 5147–5150, 5360, 6898, 6932–6934, and 7169.

7056 (CONF-720823-P2, pp 703-717) CONFINEMENT OF AIRBORNE ACTIVITY FROM MELTED ANTIMONY SLUGS. Little, J. W. Jr.; Joseph, J. W. Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, SC). Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

During charge-discharge operations of a Savannah River reactor on November 9, 1970 antimony in an antimony-beryllium source rod melted while the rod was suspended in air. The failure released some 85,000 curies of activity, about 6250 curies of which was carried by ventilating air to the reactor building's confinement filters. The filters functioned extremely well, retaining more than 99.999% of the activity. Only 3 millicuries escaped to the environs — representing 0.63% of the maximum permissible concentration at the plant boundary. The ventilation exhaust system for the reactor building includes five confinement filter compartments to contain radioactivity in the event of a reactor accident. Exhaust fans maintain a negative pressure in the reactor room, the ducts to the filters, and the compartments containing the filters. Each compartment contains moisture separators, particulate filters, and halogen adsorbers. It is unshielded, has dimensions of 9 × 22 × 25 ft, weighs ten tons, and is designed for remote removal from the reactor building roof 55 feet above ground level. Four compartments were on-line when the accident occurred. During the subsequent three-month building cleanup period the air flow gradually decreased as the filters accumulated about three times their normal dust loading. No activity escaped from the filters during the cleanup period. Immediately after the accident the maximum radiation level at the side of the hottest filter compartment was 70 R/hr, which was reduced through activity decay to 25 R/hr by the time of replacement. Removal of the contaminated compartments began on February 9, 1971 following completion of the reactor room cleanup. Compartments were pulled to the edge of the roof, lifted from the roof with a crane, and placed on a special railroad flat car for movement to an isolated location. Replacement compartments were installed, new filters tested, and the system returned to normal on February 26, 1971. Initial entry into the contaminated compartments to recover samples for detailed analyses was accomplished on March 20, 1972. Activity distributions among particulate filters were measured for the most

heavily and the most lightly contaminated compartments. One compartment had a variation of ±4% about its average, while the other had a +18% to –30% variation. Radiation damage was minimal in the most heavily contaminated compartment which had an exposure of about 10^6 R. (auth)

7057 (CONF-720823-P2, pp 848-855) ANSI/N45-8 NUCLEAR GAS SYSTEMS TREATMENT STANDARDS. Leckie, F. D. (Nuclear Containment System, Columbus, OH); Thompson, C. A. Jan 1973.

From twelfth AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

An ANSI ad-hoc subcommittee has been formed to develop standards which users, suppliers, and AEC can utilize to assure the maintaining of high efficiency nuclear gas treatment systems. This in turn should expedite the plant licensing. The scope of the subcommittee is: To develop standards, standard specifications, and method-of-test standards for the design, fabrication, installation, testing, and maintenance of very high efficiency gas treatment systems for the prevention of airborne release of radioactivity from nuclear power plants. The standards will cover the testability, maintainability, and leak and structural integrity of components and assemblies necessary to ensure performance and reliability, in addition to test methods, acceptance criteria, and quality assurance provisions needed to prove that these objectives have been met. (auth)

7058 (CONF-730414-P1, pp III.52-III.73) MONTE CARLO UNCERTAINTY ESTIMATE FOR A COMPLEX SYSTEM OF EQUATIONS. Rettig, W. H.; Ybarrondo, L. J.; Radd, M. E.; Vesely, W. E. (Aerojet Nuclear Co., Idaho Falls, IA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A Monte Carlo technique was used to establish integral uncertainty bounds on the results of a loss-of-coolant accident study. The integral uncertainty bounds were a consequence of individual uncertainties in the reactor plant parameters. Reactor system constraints were considered in both the choice of input parameters and the interpretation of results. The approach is readily extended to other classes of calculations such as neutron flux distributions, stress analyses, and heat transfer calculations. (auth)

7059 (CONF-730414-P1, pp V.1-V.25) CALCULATIONAL METHODS IN POWER REACTOR SAFETY. Okrent, D. (Univ. of California, Los Angeles); Holland, L. K.; Moffette, T. R.; Moore, J. S. 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Safety aspects and safety analysis methods for BWR, PWR, HTGR, and LMFBR type reactors are discussed. 67 references. (auth)

7060 (CONF-730414-P1, pp V.26-V.46) COMPUTER ANALYSIS OF HTGR CORE REACTIONS FOR STEAM OR AIR INLEAKAGE ACCIDENTS. Barsell, A. W.; Chmielewski, R. D.; Moffette, T. R. (Gulf General Atomic Co., San Diego, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The OXIDE computer code developed for analyzing transient effects of accidental inleakage of steam and/or air to the primary coolant of a high-temperature gas-cooled reactor (HTGR) is described. A core spatial analysis is made of gas diffusion; steam-graphite, oxygen-graphite, and steam-carbide chemical reactions; and heat transfer within the bulk moderator and fuel rods. Application to HTGR accident sequences for safety evaluations is described. 18 references. (auth)

7061 (CONF-730414-P1, pp V.47-V.64) FAULT TREE ANALYSIS OF REACTOR SAFETY SYSTEMS WITH APPLICATION TO THE RESIDUAL HEAT REMOVAL SYSTEM OF A BWR. Erdmann, R. C.; Okrent, D.; Godbout, P.; Solomon, K. A. (Univ. of California, Los Angeles). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The development of general concepts in repair and standby and their incorporation into a numerical code used to evaluate system reliability by fault tree methods are described. This tool is then applied to the Residual Heat Removal System of a BWR where the probability of loss of isolation is determined. Using available nuclear data, the RHR system is estimated to have a mean, overall failure probability of about 2.0 (10^{-6}) per year with a dispersion ranging from 8.0 (10^{-5}) per year to 5.0 (10^{-8}) per year corresponding to input data values which exceeded 80% or 20% of the reported failure rates respectively. 18 references. (auth)

7062 (CONF-730414-P1, pp V.65-V.72) APPLICATION OF THE PAJARITO DYNAMICS CODE TO WATER-MODERATED REACTORS. Hetrick, D. L.; Foreband, H. M. (Univ. of Arizona, Tucson). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The Pajarito Dynamics Code (PAD) is a one-dimensional coupled neutronic-hydrodynamic-thermodynamic calculation system developed at the Los Alamos Scientific Laboratory. It has been used to simulate destructive accidents in a variety of fast and epithermal systems. The first use of the PAD code for water-moderated systems is described with preliminary results for two prototype models: a homogeneous reactor to simulate experimental studies of criticality accidents in uranium nitrate solutions; and a heterogeneous reactor to simulate destructive excursions in aluminum-water systems. 8 references. (auth)

7063 (CONF-730414-P1, pp V.73-V.99) NEW METHOD FOR THE EFFICIENT NUMERICAL INTEGRATION OF THE SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS FROM THE ANALYSIS OF LOSS-OF-COOLANT ACCIDENTS. Hofer, E.; Werner, W. (Technische Univ., Munich). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The simulation of loss-of-coolant accidents with the aid of multinode point models requires the stepwise numerical solution of a system of nonlinear ordinary differential equations for pressure, enthalpy, mass and massflow. Some characteristics of this system impose severe time-step restrictions on explicit but not on implicit integration techniques. Purely implicit methods, however, are handicapped in other respects. A combination of an implicit and an explicit formula in conjunction with an extrapolation algorithm is introduced. It has proved to be an efficient numerical technique for the integration of the system mentioned above. 9 references. (auth)

7064 (CONF-730414-P1, pp V.105-V.124) FUEL MOTION MODEL FOR LMFBR UNPROTECTED LOSS-OF-FLOW ACCIDENT ANALYSIS. Bohl, W. R.; Stevenson, M. G. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A description is given of a new model (SLUMPY) which treats fuel motion in sodium voided subassemblies under conditions appropriate to an unprotected loss-of-flow accident in an LMFBR. SLUMPY is designed to operate as a module of the SAS2A multichannel accident analysis code. SLUMPY uses compressible hydrodynamics to describe a growing "slumped" region which develops as fuel melts and provides a prediction of the motion of the fuel under the influence of gravity, fission gas, and fuel vapor driving forces. 6 references. (auth)

7065 (CONF-730414-P1, pp V.125-V.136) REALISTIC UPPER BOUNDS FOR REACTIVITY INSERTION FROM SLUMPING FUEL. Hummel, H. H.; Kelber, C. N. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Mathematical models and computational techniques for analysis of nuclear systems.

Under realistic conditions the effect of incoherence combined with the inherent characteristics of slumping of fuel under gravity

establish an upper bound for reactivity insertion rate from this source well below that conceivably possible. The ramp rate for a given possible total reactivity insertion increases with coherence of slumping; however, a high degree of coherence is most likely at high power, when not much reactivity can be inserted and therefore not much time is available for acceleration of slumping fuel. 7 references. (auth)

7066 (CONF-730414-P1, pp V.137-V.158) SAS/FCI: A FUEL-COOLANT INTERACTION MODEL FOR LMFBR WHOLE-CORE ACCIDENT ANALYSIS. Smith, L. L.; Travis, J. R.; Stevenson, M. G.; Dunn, F. E.; Fischer, G. J. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A molten fuel-coolant interaction model is described for the analysis of LMFBR hypothetical core disruptive accidents. The concept of a point model is employed, but in addition to a uniform interaction zone in the coolant channel, a uniform fuel-pin cavity pressurized by fission gas is modeled for the ejection of fuel and fission gas from the fuel pin to the interaction zone. Both the fuel-pin cavity model and the interaction zone model permit time-dependent masses for their respective components. Pressurization of the interaction zone is relieved by motion of the inertial liquid sodium slugs which constrain the interaction zone volume, by heat transfer from the interaction zone sodium to the subassembly structure and fuel-pin cladding, and by addition of subcooled sodium to the interaction zone. Reactivity feedbacks due to sodium voiding and fuel loss from the fuel pin are calculated by assuming uniform density decreases, whereas that due to fuel motion in the coolant channel is calculated by assuming uniform dilation of the interaction zone. 8 references. (auth)

7067 (CONF-730414-P2, pp IX.59-IX.71) IMPROVEMENT OF AND CALCULATIONS WITH THE TWO-DIMENSIONAL SPACE-TIME KINETICS CODE FX2. Ferguson, D. R.; Daly, T. A.; Fuller, E. L. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The FX2 code is intended for use in LMFBR disassembly analyses. It employs a model consisting of two-dimensional (r-z) multigroup diffusion theory, Lagrangian hydrodynamics, an energy balance, and an energy-density-dependent equation of state. A production version of FX2 is being completed which includes a number of refinements to the original model and solution algorithm. These refinements, coupled with an efficient data management strategy, have significantly reduced the running times of the code. Using a preliminary version of FX2, a hypothetical LMFBR transient resulting in fuel slumping has been analyzed in order to compare the FX2 space-time results with results from point kinetics and static k-difference calculations. 16 references. (auth)

7068 (NP-19875-P1) POTENTIAL ENVIRONMENTAL EFFECTS OF AN OFFSHORE SUBMERGED NUCLEAR POWER PLANT. (General Dynamics Corp., Groton, Conn. (USA). Electric Boat Div.). Jun 1971. 328p. GPO $2.50.

Potential environmental effects of wastes from an 1190-MW(e) pressurized-water nuclear power plant, submerged 250-ft deep at four representative sites off the U. S. mainland, were studied. The thermal field of the plant's cooling water discharge, and the distribution of radionuclides in the sea, were analyzed. In every case, the thermal mixing zone (by the most stringent present standards) was found to end before either a surface or subsurface field was established, and to be much smaller than for a plant in shallower waters. Fewer organisms would be killed by entrainment in the cooling water than at a coastal plant. A batch release of radionuclides, after the worst hypothetical nuclear accident, would harm marine life, requiring suspension of local fishing for about 10 weeks. No potential ecological damage was predictable from the ordinary minute release of radionuclides, the thermal discharge, or other wastes. Volume 1 presents the rationale, analyses, and results of the complete study. Volume 2 is a descriptive treatise and collation of data on the representative offshore sites, which forms the basis for application of the analytical models to those sites, and for the assessment of the effects of power plant wastes on the marine biota. (auth)

7069 (NP-19875-P2) POTENTIAL ENVIRONMENTAL EFFECTS OF AN OFFSHORE SUBMERGED NUCLEAR POWER PLANT. (General Dynamics Corp., Groton, Conn. (USA). Electric Boat Div.). Jun 1971. 303p. GPO $2.25.

7070 (STI/PUB-342) PRINCIPLES AND STANDARDS OF REACTOR SAFETY. Proceedings Series. Proceedings of a Symposium Held at Juelich, Germany, February 5–9, 1973. (International Atomic Energy Agency, Vienna (Austria)). Aug 1973. 660p. (In English and French). (CONF-730217-). IAEA $29.00.

Thirty-four abstracts were prepared concerning the philosophy of safety design, quality assurance and reliability, design for natural and man induced disasters, siting considerations, design safety features, safety operation, and HTGR reactors. Six abstracts were previously announced in NSA. (FS)

For abstracts of individual papers see: 5097, 7071–7102, and 7335.

7071 DEVELOPMENT OF ADEQUATE RISK STANDARDS. Farmer, F. R. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 3-9 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

In the day-to-day control of radiations and effluents, concern has been expressed about the long-term effects of low level exposures received by large numbers of people. This concern about individual exposure level may also apply to small accidental releases of radioactive materials. There have been several attempts to provide a background showing the frequency with which man is at risk from various natural and unnatural causes, generally ranging from 10^{-3} to 10^{-6} per person per year. Whereas this background may help in determining the frequency level of so-called tolerable repetitive events, it has little connection with large and infrequent accidents. The undesirability of these events may stem from their total impact on society of shock, cost, death, disturbance etc., and be judged at the time in relation to the means of avoiding future risks or of reducing their consequences. If we are to seek any measure of collective opinion about the undesirability of a nuclear accident, we need first to describe the event. There have been many studies, from WASH. 740 onwards, of the effect of releasing to atmosphere various fractions of fission products. The effect of nuclear accidents is not exaggerated or over emphasized, but will outline the likely consequences of releasing 10% of gas and volatile fission products in average weather conditions. Whether occurring in the United States of America, Europe, or elsewhere, the event could cause a severe set-back to the future growth of nuclear power. An argument is developed leading to a proposition that the risk of such an event occurring at any time, anywhere, from the reactors now being built or commissioned in this decade should be less than 1 in 10, and preferably 1 in 100. This may be transcribed as a risk from any one reactor, in any year, of less than 10^{-4}. Formulating an objective of this kind helps clear our minds about the degree of confidence we need to have in the technology of nuclear power engineering. The achievement of such a definitive low risk shows the gaps in our defences left by present organizational arrangements and our capabilities are questioned. (auth)

7072 POSSIBLE STANDARD OF RISK FOR LARGE ACCIDENTAL RELEASES. Beattie, J. R.; Bell, G. D. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 11-32 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Everything which is possible and reasonable should be done in the design, construction and operation of nuclear reactors to ensure that accidental releases of radioactive fission products cannot occur. Nevertheless, even when all such measures have been taken, there will remain a residue of foreseeable but unavoidable faults which in combination could lead to releases of radioactive fission products having significant adverse effects on the safety of the public, even though the probability of occurrence of such releases will be very small. The nature and magnitude of these effects are predicted for a range of releases of the gaseous and volatile fission products. Taking into account the probabilities of the events, loss of life and loss of property are considered, and both of these may be regarded as monetary loss per unit time. The levels of effort and expenditure allotted to reactor safety must be limited in practice, as human resources are necessarily limited. The appropriate limits may be judged in part from comparisons with other risks run by individual members of the general public in the course of everyday life. However, a study of risks to a regional population which might be affected by a reactor accident shows that these, and not the risk to the nearest individual, are the questions of importance. It must also be borne in mind that other parts of modern industry are

offering increasing risks to the community, and it is important that the risks of nuclear power should be viewed in perspective. Such considerations lead one to identify some low probability as a possibly acceptable standard of excellence to be met in planning against a large reactor accident release. (auth)

7073 CURRENT SAFETY PHILOSOPHIES FOR DESIGN AND OPERATION OF NUCLEAR POWER PLANTS. Sarram, M. (Teheran Univ.). pp 33-40 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Experience has shown that the current safety philosophies practised in the design of nuclear power plants and their operations are more than adequate; however, one must always plan for additional safety measures. One of the main problems to be considered in evaluating the safety of a power plant is the reactor structural design, in particular the containment. The current containment systems constructed for thermal power plants may be classified as pressure containment, pressure suppression containment and multiple containment systems. Salient design features of the multiple containment system and its safety philosophies are presented. Another main problem encountered in the design of power plants is the philosophy of secondary safety systems. The importance of a secondary safety system such as emergency cooling comes into the picture when one considers the following figures for energy releases in a typical PWR, 185 MW(e), Maximum Hypothetical Accident, with 20% concept of stretch; nuclear excursion: 2×10^7 Btu, chemical reactions: 10^7 Btu, decay heat: 3×10^7 Btu; and stored energy in coolant: 10^8 Btu, which is an order of magnitude higher than others. Other standard limits for risk evaluation and safety measures to be used for design of nuclear power plants are presented. (auth)

7074 QUALITY ASSURANCE FOR REACTOR SAFETY. Deckers, J.; Lindackers, K. H. (Technische Ueberwachungs, Cologne). pp 51-61 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The focal points of a quality assurance program as a contribution to reactor safety are discussed. They refer to the quality of the materials and semi-products, the quality of the parts and of the installation as such, to the redundancy and diversification of the quality assurance and to the documentation of the tests and the test results. (auth)

7075 RELIABILITY IN A SAFETY ANALYSIS METHOD. Carnino, A.; Quenee, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 63-78 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

In a safety analysis, reliability is an important element in the quantitative assessment of safety. Before reliability can be estimated in numerical terms, a logical analysis has to be made of the reactor in operation. The steps defined below show the process to be followed in making such an analysis: preparing logical diagrams illustrating reactor operation under various design conditions; ascertaining "critical" points (barriers and essential functions), followed by determination of the equipment and "critical" components; defining, by means of these critical points, accidents which should be taken into account; examining systematically the equipment affected by such decisions (this stage is of the utmost importance and makes checking of the consequences of accidents possible); seeing how to optimize the system in order to obtain the required degree of reliability and to reduce the consequences of the failures; and arranging for the systematic collection of information on the operation of equipment recently analyzed and for the study of operational data on the reliability of this equipment or, failing that, of similar equipment. Following the completion of these steps, it would be possible to estimate the reliability of a system in respect of accidents analyzed by using codes for calculating the reliability of complex systems. (auth)

7076 RELIABLE SYSTEMS FOR ELECTRICAL POWER SUPPLY IN NUCLEAR POWER PLANTS. Stute, H.; Mitsostergios, K. (Technische Ueberwachungs, Cologne). pp 79-91 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The present state of the use of systems ensuring the safety of the electrical power supply in nuclear power plants is discussed. The importance of the safety of these systems is described. A review of conventional steam power stations indicates the degree of reliability required of these systems. These requirements are incorporated in further considerations and form the basis for the improvement of similar systems in nuclear power plants. Additional reliability requirements are described in a section on system development in nuclear power plants. All these requirements are incorporated in the design of electrical systems and the following items are discussed: the possibility of the reliable connection of the nuclear power plant to the supply lines (to obtain energy); the importance of power supply from the main generator for safety reasons; the distribution system design concept; and the design of the emergency switchyard and the considerations in planning the various concepts. Reliability calculations are not considered. The methods of danger and failure effect analyses common in reliability analysis are briefly discussed. (auth)

7077 PROBLEMS AND LIMITATIONS OF RELIABILITY CALCULATIONS FOR COMPLEX SYSTEMS. Schallopp, B.; Kamarinopoylos, L. (Buero Schallopp, Berlin). pp 93-104 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The main purpose of all reliability work is the search for weak parts that might cause accidents or hamper the restriction of the consequences of accidents and to raise the overall reliability to an acceptable level. The mathematical, i.e. statistical, approach is commonly restricted to systems with well-tried or heavily investigated components for which reliable figures for fault probabilities etc. are available. Indispensable for all mathematical calculations is the Failure Effect Analysis, which commonly results in a Fault Tree. General remarks about the two usual approaches, the analytical and the simulation methods, are presented. Three groups of analytical methods are considered and the conclusion is reached that they can have great worth in special cases, particularly with small systems, but that they prove insufficient for the treatment of real, complex systems with repairable components, unrevealed faults, etc. Simulation methods offer most convenience and flexibility and can be easily formalized so that their use does not presuppose a knowledge of all program details. Unfortunately this is true only for direct simulation, which requires too much computer time for complex systems with probabilities lower than 10^{-14}. Simulation using variance reducing methods, including possibly the consideration of the separately explored critical paths, allows the calculation of probabilities of 10^{-7} or even 10^{-8} but at the costs of convenience and flexibility. In cases where still smaller probabilities have to be estimated one is forced to simplify the system on the basis of a very thorough fault analysis to allow analytical treatment. These difficulties imply the question of the worth of simulation procedures, which is discussed with reference to an actual example. (auth)

7078 SAFETY ASSESSMENT OF SYSTEMS. Green, A. E. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 105-119 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Systems which safeguard high risk situations require a high integrity of operation. Certain types of control systems, shutdown systems and emergency supply systems of nuclear reactors fall into this category. It is important to determine for these systems that their reliability in the safety sense is adequate. The practice in the U.K.A.E.A. and other similar organizations is to carry out an independent reliability and safety assessment of those reactor systems on which safety is dependent. The process of safety assessment is to determine the safety objectives, the conditions under which they must be met, and the corresponding required performance of the appropriate system. The actual system performance is then assessed, which involves an appraisal of the complete behavior of the overall performance characteristics under all relevant conditions. The assessed actual performance is then compared with the required performance and a conclusion drawn as to the adequacy of the system. Such a safety and reliability assessment cannot be completely deterministic. This is so since there is always a chance that sometimes a system will work as required and sometimes it will not. The general study of this chance pattern of variation is the crux of the safety problem and involves the quantification of system

reliability in some probabilistic form. The quantification of safety and reliability in a complex system often depends upon techniques for evaluating the composite effect of the reliability associated with each constituent part of the system. This requires a comprehensive methodology for synthesizing system reliability, a means of selecting critical areas and an adequate availability of reliability data associated with the engineering parts. This whole process of safety assessment is not static but represents a growth from an initial understanding at the system design stage to the substantiation of actual operational performance. The type of safety assessment described has been successful in a number of applications and these benefits are reviewed. Generally, this form of safety and reliability technology can lead to a better understanding of safety problems, can enable rigorous design comparisons to be made and can logically quantify the results of development and experience. (auth)

7079 COMPARISON BETWEEN DETERMINISTIC AND PROBABILISTIC DESIGN METHODS APPLIED TO A REACTOR SAFETY CONTAINMENT. Cesari, F. (CNEN, Bologna); D'Aloisio, A.; Volta, G. pp 121-132 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

A study made on the safety containment originally built for the PRO reactor and now destined to be used for the fast reactor PEC is presented. The containment, designed at that time according to the ASME VIII code and the Italian regulations for pressure vessels has been re-evaluated in this study on the basis of the ASME III code. The discrepancy of the results as to the maximum permissible pressure was critically examined in the light of the assumption implicit in the various codes. Then a probabilistic evaluation was made assuming statistical distribution for strength and load extrapolated from experimental data, when these were available. A comparison between the probabilistic approach and the "safety factor" or "code" approach has given evidence of the advantages of the former in two respects: the variability factors are explicitly introduced; and the load variability can more easily be taken into consideration. The second aspect is of great importance in the case of safety containment where the design loads are of an accidental nature. (auth)

7080 SAFETY ANALYSIS OF POWER REACTORS IN FRANCE: GENERAL PRINCIPLES AND PRACTICAL APPLICATIONS. Bourgeois, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 147-168 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Before licensing the construction or operation of nuclear installations, the French administrative departments responsible for granting such authorization require a technical study to be made of the provisions envisaged for ensuring a satisfactory degree of safety. The general principles which have been applied thus far in the analysis of nuclear reactor safety and specific examples of application are presented. The technical evaluation of a reactor's safety is based on examination of the integrity of the various barriers interposed between the radioactive products and the public. Thus, a definite picture emerges of the measures taken to prevent any impairment of barrier integrity. The study of large-scale accidents is made only subsequently and reveals the successive levels which have to be assumed as exceeded before recourse is even had to the emergency provisions. In the case of the pressurized light-water reactors built in France under United States' license, the safety analysis must of necessity relate to the criteria in force in the United States. Some adaptation is necessary to allow for different administrative and regulatory conditions. Examples of such adaptations are given. It has also been considered essential to carry out a limited program of study and research to provide supporting material on the most difficult points of the safety analysis. With regard to the sodium-cooled fast-neutron reactors, a brief account is given of the safety criteria arrived at in France on the basis of the experience gained with this technique. The method of safety analysis is the same as for the other models. Uncertainty still persists on several points which are being studied under an extensive research program. The corresponding safety criteria can therefore be made more flexible subsequently in the light of the results obtained. (auth)

7081 NUCLEAR SAFETY PRINCIPLES AND PRACTICES AT KANUPP. Nasim, M. (Nuclear Power Plant, Karachi, Pakistan). pp 169-178 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The engineered safety features of the natural uranium, heavy water moderated and cooled 137 MW(e) power reactor for the Karachi Nuclear Power Plant (KANUPP) are such that major accidents have an extremely low probability of occurrence. Engineered safeguards include systems designed to limit the damage to reactor fuel, in particular the protective system, emergency cooling system, emergency power supply and other standby equipment and safety devices. In addition, plant design ensures that the consequences of any accident are mitigated as much as possible. A number of systems are provided to prevent the escape of radioactive material in all forms. These include the building containment, the ventilation system dampers, air-locks, and the building spray systems. The concept of "risk indices" is applied in the assessment of the safety design. Internationally accepted standards for radiation protection and safety are adopted. Safety review of the design, construction, commissioning and operational plans is carried out to suit the local circumstance in conformity with international practice. Extensive testing during the commissioning period demonstrated that the performance of all systems was consistent with the design criteria and the conditions described in the safety analyses were achieved. Continuing operational plans are designed to ensure adherence to safety practices. (auth)

7082 EARTHQUAKE SAFETY OF NUCLEAR POWER PLANTS BASED ON A BALANCED RISK CONCEPT. Bork, M.; Schwarzer, W. (Technische Ueberwachungs, Cologne). pp 181-194 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Criteria for the design of nuclear power plants against seismic events have been developed to a high degree of perfection in countries of high seismicity such as the United States of America and Japan, where damage from earthquakes has frequently occurred. On the basis of the experience gained in the licensing procedures for the newer nuclear power plants, a set of seismic design requirements has been drafted in the Federal Republic of Germany. They are an example of how the problem of earthquake safety can be solved in areas of low and, at most, medium seismicity. These criteria include requirements that should be considered in evaluating the seismological conditions of a site and in demonstrating the suitability of the seismic design of a plant. The requirements are discussed in comparison with those defined for both the United States of America and Japan on the basis of the differences prevailing in the seismic conditions. (auth)

7083 DOSE AND RISK CONSIDERATIONS FOR THE RELEASE OF ^{131}I AT SPECIAL SITES. Bayer, A. (Kernforschungszentrum, Karlsruhe, Ger.). pp 198-214 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Dose and risk considerations for the release of ^{131}I from nuclear installations are studied for the Upper Rhine Valley between Basel and Mainz where an accumulation of nuclear power plants is expected and effects of superposition must be taken into account. ^{131}I is taken as the critical isotope. The iodine incorporated is deposited in the thyroid gland. The possible effect of this radiological burden is thyroid carcinoma. The age-dependent inhalation dose factors and age-dependent ingestion dose factors are shown, likewise the known risk factors for thyroid carcinoma. The thyroid doses resulting from the normal release of ^{131}I from nuclear installations are calculated and compared with the 90 mrem/yr criterion. The average annual releases from accidental events, derived from an accidental release frequency relation, are used to calculate the average doses from accidental release and to compare them with the doses from normal release. The resulting risks from accidental releases are calculated and compared with the natural risk of thyroid carcinoma. (auth)

7084 PRINCIPAL QUESTIONS OF WATER MANAGEMENT CONCERNING THE PROPOSED SITING OF NUCLEAR POWER REACTORS IN THE PROVINCE OF NORTH RHINE, WESTPHALIA. Paetze, D. (Landesanstalt fuer Gewaesserkunde und Gewaesserschutz NW, Krefeld, Ger.). pp 223-233 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Jülich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

According to the latest state of engineering nuclear power reactors still require waters of sufficient volume to receive the cooling-water and liquid radioactive waste discharges. The absorptive capacity of these surface waters is limited by their other uses. Changes in temperature, oxygen capacity, and biological effects of waters caused by the concentrated introduction of large quantities of thermal pollution determine the siting of power reactors and their distance from each other. The site of a nuclear power reactor on a fresh-water system cannot be regarded as isolated. The irradiation that a human being can receive through the exploitation of waters must be estimated from the possible total pollution and this will probably limit the number of nuclear power reactors that can be erected on any given receiving water system. Calculation of the absorption capacity will permit the timely coordination of the interests of water management with those of the power industry, which must take the expected consumption into account in its plans for new sites. This coordination is especially necessary in the densely populated areas on the Rhine and Ruhr, where the available water resources are limited. The radionuclides expelled with the exhaust air can be deposited on the ground or on the surface of waters in a fixed area around the reactor. Consideration of the siting of power reactors must include examination of the extent of their influence on groundwater. (auth)

7085 SITE SELECTION AND OPTIMIZATION OF ITS USE IN INDIA. Sarma, T. P.; Shirvaikar, V. V.; Ganguly, A. K. (Bhabha Atomic Research Centre, Trombay, India). pp 235-243 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Sites proposed for installation of a nuclear power station should be examined with respect not only to engineering feasibility and economics but also to the safety provisions required and the economic penalty to be paid to achieve it. Evaluation of safety and safety economics requires knowledge of the site as follows: availability of water for dilution of radioactive wastes in normal operation; suitability of meteorological conditions so that the dose to the public does not exceed acceptable levels; availability of an adequate exclusion area; and containment of radioactive liquid wastes generated under accident and off-standard conditions. The siting policy in India has undergone some change since the selection of the first site at Tarapur in 1960 and this is discussed. Expansion of existing sites was also considered and this has led to two important developments: planning the site utilization well in advance for installation of reactors as well as ancillary plants such as fuel reprocessing plants; apportioning of site burden 0.5R/yr to various routes (air, water and land) to various site installations taking due note of design limitations of each. The effect of meteorological factors in site selection and problems associated with availability of water are discussed. The type of hydrological investigations and demographic studies to be conducted is also mentioned. (auth)

7086 BACKFITTING THE SITE TO CHANGING RADIATION ENVIRONMENT. Kamath, P. R. (Bhabha Atomic Research Centre, Trombay, India). pp 245-254 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The impact of nuclear operations on the radioactivity of the environment is not predictable during site selection because the behavior of effluents and design performance are understood only in general terms. The safety implications become manifest only after operation begins and radioactive discharges are made. The installation of a large nuclear station is followed by an increase in activity to the population. A developed site is also an attraction for enhancing nuclear activities. To keep a balance between increasing radiation burden and normal development it is necessary to assess the quality of the environment against a changing radiation background. In water-based reactors at Tarapur and at Rajasthan the waters receiving condenser coolants become the dominant medium for: dispersion of waste effluents, ecological uptake and heat dissipation. Aqueous discharges do not form limiting criteria for operations. The aqueous discharges at Tarapur are made close to the shore. The radioactivity is traced over long distances along the coastline. At Rajasthan the discharges are released into a lake which also supplies drinking water. Surveillance at the two sites has revealed patterns of activity movement that may lead to population exposure and the spread of activity in populated areas. Safety implications of long-term operations are discussed and modifications are recommended to backfit the site for normal development. (auth)

7087 QUANTITATIVE APPROACH TO SITE EVALUATION. Tveten, U. (Institutt for Atomenergi, Kjeller, Norway). pp 255-268 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

At present the most frequently used approach to judging acceptability of a specific reactor site in a given accident situation, consists of calculating doses to the most exposed individuals outside the site area and under adverse weather conditions. The resulting doses are then required to be below certain limits. When alternative sites are to be compared from an accident point of view, this approach is not satisfactory. The actual population distribution cannot be taken into account, as only the distance to the nearest dwelling (or site boundary) matters. Neither can the effect of different meteorological conditions at the alternative sites be represented. A calculation method is proposed that gives a better basis for comparison. Instead of calculating the meteorological diffusion of released activities using standard meteorological conditions, concentration probabilities are calculated taking all meteorological data pertinent to the site into account. The probabilities of finding concentrations above a certain limit in various directions and distances from the reactor are calculated, and this is linked to the population distribution. The concentration limit may be chosen to correspond to a level below which the probability of a certain harmful radiation effect becomes small. The calculated probabilities will then directly correspond to the occurrence of this effect, and when the population distribution is taken into account, it may yield the total effect of a certain type on the population. The sum of the products of probability times population may serve as a type of "quality factor". It refers to one certain type of accident, but the method may be extended to cover a number of different types of accident. The "quality factor" will not correspond to the population dose. Only the occurrence or nonoccurrence of a certain effect is of interest. The quality factor is used to prepare a priority list of alternative power reactor sites from an accident point of view. (auth)

7088 STANDARDS AND CRITERIA IN USE OR BEING DEVELOPED FOR REACTOR SAFETY. Minogue, R. B. (Atomic Energy Commission, Washington, DC). pp 271-291 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The importance of standards, criteria, and codes for achieving safe, dependable, and economic nuclear power has been recognized by the nuclear industry and the regulatory agencies of the United States of America for a long time. The current nuclear standards program of the United States Atomic Energy Commission and its role in promulgating these standards for the design, construction, and operation of nuclear facilities are described. AEC regulations relating to radioactivity releases are historically traced from their inception to presently proposed modifications. Other regulations such as the general design criteria, the quality assurance criteria, and the seismic and geologic siting criteria for nuclear power plants are also described, as well as proposed regulations and rule changes currently in preparation. Since 1970, the AEC has issued safety guides for water-cooled nuclear reactors which are used to aid nuclear power plant applicants and licensees in complying with the general requirements and guidance provided in the Code of Federal Regulations. Many of these guides are in the area of quality assurance, an area in which much more detailed guidance is needed and many standards are presently being developed. Quality assurance program requirements for the design, construction, and operation phases of nuclear power plants are presented, and present and future standards efforts in this area are described. Guides describing good practices to be used to assure that structures, systems, and components important to safety are designed, fabricated, erected, and tested to adequate quality standards are also presented. Also described are guides which specify acceptable analytical methods and assumptions for evaluating various postulated accidents and guides which identify the information that is needed to evaluate applications for construction and operation of nuclear power plants. (auth)

7089 NUCLEAR SAFETY CRITERIA FOR THE DESIGN OF INTEGRATED PRESSURIZED WATER REACTOR PLANTS OF THE EFDR TYPE: A TENTATIVE STANDARD. Kleinert, K. P. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.); Schmidt, G.; Zeibig, H.; Seeliger, D. pp 293-317 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Elements of a tentative standard on nuclear safety design aspects of integrated pressurized water reactor plants (EFDR type) which have been developed from the nuclear steam generating system of NS Otto Hahn are presented. They cover: overall plant design, reactor core and reactivity control, reactor pressure vessel, plant protection system, residual heat transfer and electrical power supply systems, and pressure suppression and emergency cooling systems. Only those requirements of the proposed standard are discussed in detail which indicate differences between an EFDR system and other LWR systems or between a stationary and a marine EFDR system. The requirements are illustrated by short descriptions of the relevant design measures. The requirements are derived from safety and reliability analyses of stationary and marine EFDR plants and sub-systems. The analyses are based on a definition and classification of design conditions, which result from anticipated and postulated plant operational and environmental conditions and a definition of mechanical and radiological consequences of these conditions, which are considered unacceptable. By correlating conditions and consequences, design bases as well as safety related functional performance and mechanical design requirements are derived. Although a complete reliability analysis in accordance with the probabilistic consequence analysis method, known as risk approach, has not yet been performed for the EFDR system, a way to extend the present approach is indicated. (auth)

7090 RECOMMENDED DESIGN CRITERIA FOR NUCLEAR POWERED MERCHANT SHIPS. Dickinson, R. W. (Babcock and Wilcox Co., Lynchburg, VA); Levine, Z. pp 319-342 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Existing regulations of the U. S. Atomic Energy Commission provide that an application for a construction permit must include the principal design criteria for a proposed nuclear facility. The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety. General design criteria have evolved in recent years for use in the design of central station nuclear electric generating plants. The need for analogous design criteria for nuclear powered merchant ships has been recognized. Recommended design criteria for nuclear ships have been developed under an ongoing program sponsored by the U. S. Maritime Administration and have been submitted to appropriate regulatory groups in the United States of America. Although these criteria have no official sanction, they do establish recommendations for minimum design requirements for the principal design criteria for water cooled nuclear power plants to be used in merchant ship propulsion. Wherever practicable, these propulsion plants are similar in design to land-based plants for which construction permits have already been issued by the AEC. The Recommended General Design Criteria for Nuclear Powered Merchant Ships have been based on the USAEC's General Design Criteria and accepted practice for safe design and operation of nuclear merchant ships. The recommended criteria for nuclear ships with emphasis on those areas where the nuclear propulsion plant is uniquely different from its land-based counterpart are reviewed. The need for international acceptance of general design criteria is pointed out. (auth)

7091 SAFETY OF NUCLEAR PRESSURE VESSELS AND ITS REGULATORY ASPECTS IN FRANCE. De Torquat, G. (Ministere du Developpement Industriel et Scientifique, Paris); Quenlart, D.; Barrachin, B.; Roche, R. pp 343-352 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The development of nuclear power station construction in France is accompanied by important studies on the safety of nuclear pressure vessels, which constitute one of the barriers to the emission of fission products. Studies have shown the value of preparing specific regulations to cover the risks of rupturing of containment shells as a result of the pressure of the fluid inside. It is pointed out that there exists in France a system of regulations governing the establishment and operation of a nuclear power station, and also safety regulations applying to equipment under pressure. The specific regulations mentioned above are intended to implement these two systems. For example, since 1970 and as a result of prolonged study, there has been a ministerial order governing prestressed-concrete nuclear-reactor vessels. A set of regulations dealing with the primary circuit of water vessels in nuclear installations has been in preparation since 1971. It contains certain original provisions intended to comply with the spirit of the French regulations. These provisions are concerned, in particular, with defining the apparatus, the designer and his role, and also his relations with representatives of the public authorities. It will lay down the technical conditions necessary for ensuring that the apparatus is safe and, in particular, restrictions on the use of certain materials (including high-strength steels), the obligation to estimate the resistance of containments under pressure to various specified kinds of damage, and also the principles which the testing of the apparatus must satisfy from the point of view of both manufacture and operation. (auth)

7092 TREATMENT GIVEN TO IMPORTANT TECHNICAL PROBLEMS DURING NUCLEAR POWER PLANT SAFETY ANALYSES AND IN GENERAL STUDIES. Vinck, W. F.; Leonardini, L.; Maurer, H. (Commission of the European Communities, Brussels). pp 355-372 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

During safety analyses on specific first and second generation nuclear power plants of the light-water type and during studies of a more general application performed under the auspices of the Commission of the European Communities, several technical items have been dealt with in more depth and detail because of their fundamental nature in nuclear safety and its environmental implications. Such items are: prevention of rupture in the primary boundary, analysis of primary circuit blow-down effects and of the efficiency and reliability of emergency core cooling (ECC), previsions of power supply to vital protection or accident-mitigating systems and equipment. For the primary boundary, the essential piece of equipment to remain intact throughout plant lifetime, even under adverse transient and accident conditions, is the pressure vessel. Therefore, special attention must, for this crucial piece of equipment, be given to the individual case studies but, moreover, also to the development of standards and to the resolution, through research, of outstanding problem areas. A comparison is made of the design — inspection and test — requirements for this piece of equipment in various countries of the European community. This comparison demonstrates discrepancies in standards and the situation does not encourage an international market. The same situation applies also to other types of systems and components. In certain cases this may lead to a different degree of safety and protection of the public going from one country to another. (auth)

7093 EMERGENCY DEPRESSURIZATION AND COOLING OF THE OMEGA AND PHEBUS LOOPS. Fonteray, P. J. (CEN de Saclay, Gif-sur-Yvette, France); Bailly, J.; Courtaud, M.; Peltier, J. pp 373-382 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

France has undertaken a major water-reactor construction program. By way of providing supporting material for calculations of depressurization caused by burst pipes, the Commissariat à l'énergie atomique is studying appropriate experimental methods. This is being done in connection with the out-of-pile loop Omega at Centre d'études nucléaires, Grenoble, and the in-pile loop Phebus at the Centre d'études nucléaires, Cadarache. Omega, which has a capacity of 4 MW, can be used for carrying out tests on a cluster of 36 rods of actual length and for studying the laws governing heat transfer coefficients during depressurization of water reactors. This loop will be used in an effort to reproduce, within the limits of the testing section, boundary conditions similar to those observed within the limits of a fuel element in a pressurized or boiling-water reactor core during depressurization. With Phebus, an in-pile loop with a capacity of approximately 700 kW, it is intended to reproduce the behavior of water-reactor fuel under depressurization conditions. This loop is to be installed in the Cabri reactor. Tests will also be made involving rewetting of the element by different methods and to compare them from the point of view of efficiency. (auth)

7094 APPLICATION OF NON-DESTRUCTIVE TESTING TO REACTOR SAFETY: STUDY PROGRAM OF THE COMMISSARIAT a L'ENERGIE ATOMIQUE. Barrachin, B.; Chretien, N.; Prot, A. C.; Roche, R.; Saglio, R.; Tomachevski, E. (CEN de Saclay, Gif-sur-Yvette, France). pp 383-404 of Principles and

Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The role for non-destructive testing in the field of nuclear installation safety—be it fabrication testing or the in-service inspections covered by the ASME No. XI code—needs no longer to be demonstrated. A critical examination of the methods hitherto used reveals serious limitations either in the methods themselves or in the equipment used in applying them. The Commissariat à l'énergie atomique has undertaken a number of studies with a view either to improving existing methods or devising new methods. These studies regard on one hand ultrasonic methods whose present limitations are known, on the other hand the acoustic emission and its various aspects. Acoustic holography and quality improvement of radiographic images are also among the studies made by the Commissariat. (auth)

7095 DESIGN OF EMERGENCY COOLING SYSTEMS FOR GAS-COOLED REACTORS. Cave, L. (Pollution Prevention (Consultants) Ltd., Crawley, Eng.). pp 405-426 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The fundamental problems in the design of emergency cooling systems for gas-cooled reactors are discussed and it is shown that the first essential is to define clearly the safety objectives for the reactor in order that the principles of reliability engineering can be applied to the design of the emergency cooling system. The possible effects of the choice of the main reactor parameters on the design of the emergency cooling system and the interaction of these factors on the overall cost of the reactor are also indicated. The features of various gas-cooled reactor systems which affect the design of the emergency cooling system are examined for a number of reactor types, ranging from the early Magnox reactors to gas-cooled fast breeder reactors. It is shown that the use of steam drives for the main gas circulators may ease the problems of attaining the required reliability in the emergency cooling system, but conversely the use of an integrated primary pressure circuit may lead to increased difficulty in the design of the emergency cooling system. Some frequently encountered errors in the design of emergency cooling systems are described briefly. (auth)

7096 EXPERIENCE IN OPERATING FRENCH NUCLEAR POWER STATIONS: LESSONS DRAWN FROM RECENT INCIDENTS. Clement, B. (CEN de Saclay, Gif-sur-Yvette, France); Grangetas, J. pp 447-458 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Rather than make a statistical analysis of the incidents which have occurred in French nuclear power stations since they came into operation, the authors have preferred to describe some recent incidents and refer to their implications from the point of view of safety. For the most part, these incidents are connected with the behavior of internal structures subject to gas flows and deterioration of fuel elements and with reactor control. Such incidents have often entailed unusual damage (tearing of metal plates, cracking of guide-blades in the primary tubing, oxidation of considerable quantities of uranium) but have not seriously impaired safety. They do, however, raise important problems of prevention and surveillance. Some of the incidents demonstrate the difficulty of interpreting measurements during a confused situation and the resultant difficulty for operators in taking decisions; they also draw attention to the value of periodic reexaminations of instructions. An analysis of "difficult situations" generally reveals one or more improvements which could be made to other installations. The lessons drawn in the various fields will have served a useful purpose if they further improve safety levels. (auth)

7097 SAFETY EXPERIENCE IN THE OPERATION OF A BWR STATION IN INDIA. Abraham, P.; Pattnaik, D.; Soman, S. D. (Bhabha Atomic Research Centre, Trombay, India). pp 459-471 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The basic criteria and procedures adopted in India for ensuring safety in the operation of atomic power stations are discussed. The safeguard features engineered into India's first station at Tarapur, at 400 MW(e) twin unit BWR in operation since 1969, to meet safety standards are described. The design efforts to minimize, control and monitor the environmental releases are discussed. The limits prescribed for the radioactive effluents from the station are given. Operating experience at Tarapur in achieving the safety standards is summarized. Safety problems encountered in the operation, maintenance, refueling and inspection of the station are described, with special emphasis on those peculiar to developing countries. Unusual occurrences related to safety are analyzed and remedial measures taken to prevent recurrence of such events are discussed. Difficulties in "backfitting" atomic power stations are highlighted. A summary of the personnel radiation exposures of station personnel during the four years from the commencement of operation is presented. The causes for the high exposures are investigated. Data on the solid, liquid and gaseous radioactive wastes released from the station are given. Information on the proposals to augment the existing radioactive waste systems to reduce the gaseous and liquid waste releases to the environment is provided. Results obtained from environmental monitoring around the station are presented and discussed. (auth)

7098 HTR EMERGENCY COOLING. Kirk, J.; Sell, J. E. (British Nuclear Design and Construction Ltd., Leicester, Eng.). pp 541-561 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

A brief description is given of the BNDC podded boiler design for a 786 MW(e) HTR. Heat is removed by four main coolant loops. The helium is circulated by four electrically driven single stage centrifugal machines and passes downwards through the core and upwards through the four pod boilers. On the secondary side, the water-steam flow is downwards through the boilers. The steam passes to a single 660 MW turboalternator which is connected only to the grid system. Particular emphasis is given to the systems required for emergency core cooling following a reactor trip. Advantage has been taken of the high thermal storage property of the HTR core in designing an essential electrical system based on continuously running steam turboalternators. Steam for these sets is taken from four additional pod boilers, of much lower capacity than the main ones, and during normal operation these supply the house load and contribute to the total generating capacity of the station. Following a trip, the main boilers and turbogenerator are shut down and the emergency duty boilers and turbines continue to operate to supply the post trip electrical loads. The gas is circulated through the emergency boilers by electrically driven units but passes in the downwards direction through the boilers. On the secondary side the steam/water passes through the boiler in the upward direction for improved stability at low feed flows. The results of calculations are given which show the required level of post trip cooling for various fault situations. It is shown that adequate diversity and redundancy of plant is provided to meet these cooling requirements to an acceptable degree of reliability. (auth)

7099 PLATE-OUT EVALUATION AS A BASIC CRITERION FOR PLANT DESIGN AND SAFETY ANALYSIS IN INDIRECT AND DIRECT CYCLE HTR SYSTEMS. Mielken, G.; Will, M. (Kernforschungsanlage, Juelich, Ger.). pp 563-578 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

In modern high-temperature gas-cooled two cycle reactor plants, but also in HTR reactors coupled directly to a gas turbine (HHT), the design criteria are to a large extent determined by the questions of fission product release from the core and deposition of solid fission products and their distribution within the reactor system. For the indirect cycle system the problem mainly lies in the release of iodine and strontium in the case of a water ingress accident coupled with a leak out of the primary circuit. For the direct cycle system the main difficulties arise from the maintenance of the turbomachinery and eventually repair of gas ducts which have to withstand high strains caused thermodynamically. In this latter case only γ-emitting radioisotopes are important, especially ^{137}C and its successor ^{137m}Ba. A survey is given on the status of knowledge concerning fission release from the fuel and plate-out distribution in HTR-systems. The mathematical models for calculating fission release and fission product deposition and desorption are described. While the motion of fission products from the coated particles to the fuel surfaces is due to mass transport within the graphite, the evaporation from the

fuel and the plate-out distribution is based on the mass transport characteristics between coolant and surfaces of the reactor system. Typical results are presented for the indirect and direct cycle systems together with the related radiological effects. In addition still open questions are discussed. The running investigations in the experimental as well as the theoretical field to get the still missing information are described. (auth)

7100 BEHAVIOR OF SOLID FISSION PRODUCTS IN HIGH-TEMPERATURE REACTORS. Cautius, W. (Arbeitsgemeinschaft Versuchs-Reaktor GmbH, Dusseldorf); Schulten, R. pp 579-582 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The AVR reactor has been in operation for more than four years now. Experience gathered throughout this period resulted in a great deal of important knowledge on the behavior of fission products. It was surprising to discover that the gaseous fission products krypton and xenon are present in the primary circuit of the reactor also in a relatively low concentration. Moreover, the dismounting of special reactor components showed a very low surface contamination of solid fission products. Spherical graphite fuel elements, which are being used in the AVR mixed with other fuel elements, also showed only small traces of contamination. This was indicated by post-irradiation tests. Similar results were obtained when bypass filters were used for repeated purification of the complete helium content of the reactor. However, the question of whether solid fission products deposited on the heat surfaces of the connected steam generators are released in the upper hot part of the reactor remains to be answered. In an attempt to study this problem in detail, a new device was installed in the AVR with which the content of solid fission products can be traced immediately. First results are already available. (auth)

7101 DEVELOPMENT OF COATED FUEL PARTICLES FOR INCREASED SAFETY REQUIREMENTS. Foerthmann, R. (Kernforschungsanlage, Juelich, Ger.); Gyarmati, E.; Nickel, H.; Hilpert, K. pp 583-598 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

The ceramic nuclear fuel of high temperature gas-cooled reactors (HTGR) is compacted into graphite fuel elements in the form of coated particles consisting of small spherical fuel kernels and several different layers of pyrocarbon for fission product retention. The average fission gas release is about $R/B = 10^{-5}$, but some of the solid fission products are released in larger amounts up to $R/B = 10^{-4}$. For special types of HTGRs the development of coated fuel particles for increased safety requirements was started. The aim of this program is a better retention of the solid fission products in coated particles. The well-known decrease of strontium release by silicon carbide interlayers was found to be a function of the SiC structure and density. Therefore the correlation between the coating conditions during the deposition of SiC and its properties is studied in detail. In addition to this work new kernel materials have been developed which retain solid fission products in the fuel kernel by solid-state chemical reactions with special refractory oxides added to the kernel material. Some weight per cent Al_2O_3 in the fuel kernel react with strontium and barium forming the compounds $SrAl_2O_4$ and $BaAl_2O_4$, thus reducing the release of these fission products from the kernel by a factor up to 100. The same effect is found for the fission product cesium if a mixture of Al_2O_3 and SiO_2 was added to the kernel material forming the refractory compound $CsAlSi_2O_6$. In the case of barium the mechanism of kernel retention was studied in more detail by measurements of vapour pressure and by irradiation experiments for investigating the influence of fast neutrons on the solid fission product transport behavior in coated particles. (auth)

7102 SAFETY PROBLEMS OF FUTURE PROCESS-HEAT REACTORS. Barnert, H.; Kugeler, K.; Kugeler, M. (Kernforschungsanlage, Juelich, Ger.). pp 599-608 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Based on a reactor design for a typical application of process heat (methane cracking), novel features are shown to evaluate the reactor safety. The process shown here is representative of the use of nuclear reactor heat for the cracking of natural gas and gasoline, for the hydro-gasification of carbon, and for the generation of olefine. New components, in particular the heat-exchangers, are studied in detail with regard to their safety criteria. The following accidents are discussed: rupture of a coaxial tube between nuclear reactor and heat-exchanger; the removal of after-heat, and rupture of a tube in a process heat-exchanger (new criteria by gases and relations of pressure other than steam generation). (auth)

7103 (WCAP-7931) PWR FLECHT FINAL REPORT SUPPLEMENT. Cadek, F. F.; Dominicis, D. P.; Yeh, H. C.; Leyse, R. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Oct 1972. Subcontract S-7045. 265p. Dep. NTIS $15.25.

For Westinghouse Electric Corp., Pittsburgh, Pa.

A series of sixteen bottom flooding tests were performed with the PWR-FLECHT test facility to extend the range of FLECHT data to various combinations of low system pressure (15-20 psia), low flooding rate (as low as 0.4 in/sec) and low subcooling (~ 20°F). Also, the effect of peak power and test section flow housing temperature were investigated at these conditions. The test results include transient heat transfer coefficients and clad temperatures at different axial and radial locations. Axial pressure drop, local coolant temperature and liquid carryover were also measured. It was found that heat transfer coefficients increased with flooding rate and system pressure. It was also observed that lower system pressure increased the measured liquid carryover and lowered the velocity of the quench front. Low subcooling was found to increase the quench time but had no effect on heat transfer coefficient until late in the runs. Lowering the peak power increased the heat transfer coefficient for times greater than 120 seconds after flood. The heat transfer coefficient correlation presented in WCAP-7665 was modified to more accurately predict the data at the conditions of the current tests. (auth)

7104 (WCAP-8163) REACTOR COOLANT PUMP INTEGRITY IN LOCA. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1973. 154p.

Studies undertaken by Westinghouse into the behavior of the reactor coolant pump under conditions associated with a hypothetical loss of coolant accident are described. The studies included investigation of the thermal and hydraulic transients associated with the postulated accident with the object of determining the speed reached by the pump. Also included was a detailed structural evaluation of the pump considering time varying loads associated with transient speed increases. The results of the studies indicate that in the unlikely event of a reactor coolant pipe rupture, there is a very high probability that the pump will not be structurally damaged. (auth)

7105 ESTIMATION PROBLEMS OF SAFETY SYSTEMS. Kovanic, P. (Inst. of Theory of Information and of Automation, Prague). pp 399-407 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Safety systems should minimize at every moment in time a risk-function of at least two competitive components: (1) the missing of an actual emergency state, and (2) unnecessary loss of plant availability. A quantitative base for optimization can be provided by choosing a relevant statistical model of the process, a proper estimation technique and a system of criteria for an evaluation of the quality of the safety system. Important specific features and tasks of safety systems involve complications not present in well-known approaches to the state estimation problem of the control theory. Some results of theoretical investigations of suitable estimators are given in the paper together with a discussion on the role of a-priori information within the estimating procedures. These results can be useful in considering the practical consequences of different trip-level settings of both analog and digital-type safety systems. Solution of these problems and some conclusions on the choice of estimating algorithms and on the usefulness of process covariance matrices may also be important for the application of computers directly or indirectly related to a safety system. (auth)

7106 DESIGN FOR RELIABILITY OF THE TWO-OUT-OF-THREE PROTECTIVE SYSTEMS WITH AUTOMATIC TESTING AND REPAIR. Zobor, E. (Central Research Inst. for Physics, Budapest). pp 409-440 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

It has been a current practice in the Central Research Institute for Physics in recent years that the reactor protection systems are designed with automatic self-checking. Together with the construction of such systems, theoretical work has also been carried out on the estimation of system reliability. Starting from results of previous work in this field, the Markovian process describing the behavior of the "two-out-of-three" protective system with self-checking and repair are presented. Dividing the system states into successful and unsuccessful ones, the reliability is interpreted as the probability that the system is in one of its successful states. The effect of design philosophy and repair strategy is discussed in detail and diagrams to meet the technical requirements (e.g. for how long the reactor can be operated with one unfailed channel) in the design of such protective systems is given. (auth)

7107 RELIABILITY PROBLEMS THROUGH THE USE OF COMPUTERS IN REACTOR PROTECTION SYSTEMS. Hoermann, H. (Technische Univ., Munich). pp 441-449 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The problem of ensuring the correct operation of the system assuming a faultless hardware configuration to secure an error-free software package is described. Particular attention is given to possible program part interferences, which make a complete software test very difficult. The specifications for an overall hybrid simulation are described, which is planned in connection with the developments for a LWR protection system to check the correctness of the designed computer functions. Methods for the continuous hardware fault supervision are discussed. In this way any component failure has to be recognized instantly, to guarantee a safe reaction of the associated trip line in order to maintain the effectiveness of the two-out of-three principle. Programmed failure detection routines for memory, instruction and I/O-system tests combined with a program flow control function are described as possible means for a fast recognition of an incorrect computer operation. Basic aspects of the necessary new ways for reliability assessment of computerized safety systems are pointed out. (auth)

7108 INCIPIENT CORE ACCIDENT DETECTION. Mochizuki, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Matsumiya, M.; Nakamoto, K.; Hoshi, T.; Miyazawa, T. pp 557-570 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

From the safety aspect of fast-breeder reactors, the early warning system plays a very important role for detecting in-core accidents. Sodium boiling may be one of the earliest indications of fuel-channel blockage which would cause core damage. To date several acoustic methods for the possible detection of boiling have been proposed and investigated. Directly immersed-type acoustic detectors which are reliable at temperatures up to 600°C were developed. For evaluation, the transducer testing was carried out by utilizing water-calibration facilities, a furnace facility and a sodium boiling loop. In the acoustic method for detecting sodium boiling, it would be necessary for signals of various frequency regions to be combined and analyzed, and a diagnosis of the sodium boiling would have to be made. (auth)

7109 EXPERIMENTS FOR DEVELOPMENT OF METHODS AND SYSTEMS TO DETECT SODIUM BOILING IN AN LMFBR. Edelmann, M. E.; Ehrhardt, J.; Massier, H.; Vogel, K. (Kernforschungszentrum, Karlsruhe, Ger.). pp 571-586 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Sodium boiling in an LMFBR has a reactivity effect consisting of a transient part followed by an oscillation at a frequency of 2 to 5 Hz. This reactivity effect has been selected for detailed investigations because a prospective sodium boiling detection system based on it would not need individual instrumentation for every fuel element. The principle of the measurement is to analyse the neutron flux fluctuations with regard to such characteristic patterns as caused by sodium boiling. Since at present it is impossible to generate boiling in a sodium-cooled fast reactor, a special hydro-pneumatic pile oscillator has been developed for simulating this phenomenon in the thermal heavy-water reactor FR 2 at Karlsruhe. Two in-core ionization chambers are used to detect neutron flux fluctuations caused by the generated reactivity disturbances. To extract the boiling signal from the background, filter and correlation techniques as well as spectral analysis are applied. Data processing and signal analysis are done on-line by a digital correlation and a frequency analyser in such a way that at any time the actual correlation function and the power spectrum of a signal are available for inspection. The efficiency of the method for detecting sodium boiling in an LMFBR within a few seconds, depending on detector configuration and sensitivity and on different signal-to-background ratios, is investigated. (auth)

7110 IN-CORE FLOW METER FOR A FUEL FAILURE DETECTION AND LOCATION SYSTEM FOR THE LMFBR. Mochizuki, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Matsumiya, M.; Hoshi, T.; Ogushi, K.; Hayakawa, S. pp 587-600 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

One of the most important requirements for the LMFBR is to develop the in-core instrumentation for detecting and locating fuel-channel failure. The development of an eddy-current probe-type (ECP) in-core flow meter which detects the fuel-channel blockage and emits signals for protecting the core from fuel meltdown accidents is described. The major development work consisted of the trial manufacture of several types of sensors and a performance test of each of the flow sensors in sodium; a reactor simulation test in a sodium loop of seven fuel subassemblies incorporated with outlet flow meters; and studies on the installation and maintainability of these sensors. (auth)

7111 STUDIES TO IMPROVE THE RESPONSE TIME OF TEMPERATURE MEASUREMENT AT THE OUTLET OF THE LMFBR FUEL SUBASSEMBLY. Mochizuki, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Nakamoto, K.; Hoshi, T.; Iida, S.; Naganuma, T. pp 601-612 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In the (LMFBR), it is important to detect an abnormal temperature change at the outlet of each fuel subassembly as quickly as possible. However, at present the thermocouple assembly is not satisfactory because of the poor response characteristics to temperature changes. A study was made to produce a thermocouple assembly with quick response characteristics by modifying conventional thermocouples and associated heat-transfer media. At first, the performance of various types and sizes of conventional thermocouples were studied in order to clarify the effects upon the time constant. Two methods were then tried for improving the response time. One was to modify the thermocouple assembly by improving heat-transfer characteristics. The other was to measure temperature fluctuation with a shorter time constant by using a new measuring method. In the first method, the following improvements were carried out; the tip shape of thermocouple was modified, and the space gap between a sheath and a well was reduced to a minimum and filled with liquid metal. Time constants of a modified thermocouple assembly, with a stainless steel sheathed, mineral insulated 3.2-mm-dia thermocouple inserted in a well, were 1.8 s (for ungrounded-type thermocouple) and 1.5 s (for grounded-type thermocouple), while the time constant of a conventional grounded type was about 7-8 s. The second method provided improvement for practical application and maintainability and its time constant was measured at about 0.4 s with thermocouples inserted in 13.8-mm-dia wells. Thus, it is possible to apply two methods for the rapid detection of abnormal temperature changes in the LMFBR. (auth)

7112 MONITORING THE SODIUM-WATER-TIGHTNESS IN SODIUM HEATED STEAM GENERATORS BY MEASURING HYDROGEN. Industrial Application at CGVS. Lecocq, P.; Lannou, L.; Masson, J. C. (Electricite de France, Paris). pp 613-634 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

One of the main problems in the safety of sodium-heated steam generators is to ensure the tightness of the heat-exchange surface. A detecting device for micro-leakage of water (10^{-4}-10^{-3} g/s) based on the measurement of hydrogen in sodium has been developed. It consists of a nickel membrane with one side in contact with sodium and the other subjected to vacuum (10^{-6}-10^{-4} torr)

by means of an ion pump provided with an analysis head (mass spectrometer calibrated for hydrogen). Detection of any water leakage is carried out by comparative measurement, with the same membrane, of the hydrogen content in the sodium entering and leaving the steam generator. A detection facility based on this method has been developed, and was operated for 11,500 hr (including 6,600 hr on load) during industrial-scale tests of model steam generators. These tests have made possible the industrial-scale application of the detection system and demonstrated its basic qualities: sensitivity 5×10^{-2} ppm H_2 in the sodium, quantitative limit 10^{-3} g/s of water; specificity (selective diffusion of hydrogen through the nickel) and spectrometric measurement; rapidity (response time of the detection system less than 30 s); and reliability (10,000 hr without incident). The development of a procedure to be followed on detection of water leakage inside the steam generator calls for systematic tests to study the kinetics of water micro-leakage in sodium. Such tests, involving the use of a detection system of the type described above, are in progress for leakage rates between 10^{-4} and 1 g/s. (auth)

7113 SYSTEM OF MONITORING THE DISTRIBUTION OF ENERGY RELEASE IN AN RBMK REACTOR (SKRE). Emel'yanov, I. Ya.; Konstantinov, L. V.; Postnikov, V. V.; Denisov, V. K.; Gurovich, V. Ya. (State Committee on Utilization of Atomic Energy, Moscow). pp 683-690 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The main features of the system for monitoring energy release in the 1000-MW(e) channel-type graphite-moderated boiling-water uranium reactor belonging to the Leningrad Nuclear Power Station are described. Beta-emission sensors in the form of coaxial cables having mineral insulation and a central silver core are used as the internal pickup element for energy release in the system. The sensor signals are compared in a system with given settings. Data on deviations are made available to the operator through a special mimic diagram. The monitoring system is connected with a digital computer which calculates the power of each fuel assembly in the reactor. (auth)

7114 ROLE OF FAILED FUEL ELEMENT DETECTORS IN REACTOR SAFETY. Graftieaux, J.; Vasnier, F. (CEN, Saclay, France). pp 805-817 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Most reactors have a system for the detection of fuel element failures. Its main functions are to detect fuel element failures as early as possible, to locate them and to follow their development until the defective fuel element is removed from the core. Speed of response and a constant surveillance capability are the fundamental requirements of a reactor safety system. The system must be able to trigger automatic emergency procedures; high operating reliability is essential. As a rule a specialized and—if possible—independent installation is used. The entire reactor is monitored continuously by one or more detectors, with analogue processing of the information being performed independently of the computer; it is this system which triggers the necessary safety procedures. Experiments have shown that, for gas-cooled reactors, measurement of fission gas concentrations is the most suitable method. The independence of the different gas circulation loops makes it possible to obtain an improved detection threshold as well as preliminary information on the location of the failed fuel element. A detector capable of continuous measurement ensures the detection of an incident within 20 seconds in the course of fuel handling. The design of the equipment installed at Chinon, St. Laurent and Bugey is described. In the case of water-cooled reactors, delayed neutron detection is a convenient method of surveillance, continuous measurement with a short response time being possible. Three types of installation are discussed. The RHF (high flux) heavy-water reactor has two detection systems, one of which is designed for safety monitoring and contains three measurement channels. The Osiris light "cold" water reactor has a single system with four counters and two measurement channels. In the case of pressurized light-water reactors, a system utilized in one irradiation loop consists of an assembly for measuring the gamma activity of the water and one for detecting delayed neutrons. As regards sodium-cooled reactors, three methods of overall detection have been tried in Rapsodie, the detection of delayed neutrons proving particularly suitable because of its selectivity and speed. The Phenix reactor is equipped with an assembly which takes six sodium samples for simultaneous examination by 12 measurement channels arranged in a 6×2 matrix. (auth)

7115 DETECTION OF FAILED FUEL IN A PRESSURE-TUBE BOILING LIGHT-WATER REACTOR (SGHWR). Goodings, A. (Atomic Energy Establishment, Winfrith, Eng.). pp 819-829 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Factors which influenced the choice of methods by which failed fuel is detected and located in the prototype SGHWR are described. The main installed system employs steam/water sampling followed by steam separation and the detection of rare-gas fission products in the steam by means of special beta sensitive counters. This is operated in conjunction with measurements on the turbine off-gas and backed up by monitoring steam main gross gamma activity. Some of the basic experimental work is described. Difficulties which were encountered during commissioning are discussed and more recent operational experience outlined. (auth)

7116 DELAYED NEUTRON PROTECTION AGAINST MELT-OUT IN STEEL PRESSURE VESSEL MAGNOX REACTORS. Burton, L. K.; Hudd, W. H. R.; Longworth, J. P.; Souch, A. E.; Wilkins, K. (Berkeley Nuclear Labs., Eng.). pp 831-842 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The consequence of rapid failure of metal fuel with a low melting-point alloy cladding is reviewed in the light of two such failures, at Chapelcross and St. Laurent des Eaux. The long time taken to restore the reactor to full power operation leads to a large economic penalty and this may be enhanced by further tripping due to contamination of the circuit. The inadequacy of current failed-fuel detection and location systems in preventing such an incident and the difficulty of ensuring their efficiency under all circumstances has led to the investigation of other possible means of protection. The method selected, from several possibilities, was that of detection of delayed neutron emitters, in the circulating bulk coolant gas, at the outlet ducts of the reactors. Early trials established the feasibility of the method and determined sensitivity and speed of response. Questions of transport in the presence of aerosols are discussed in view of their significance under accident conditions. A final set of tests were conducted in a test reactor in which two elements were melted and satisfactory signals received at a suitable time, after can melting but well before incipient fuel bar failure. The design of final installations required detailed studies at each power station to be equipped. In addition, correlation of the melt-out experiments with power reactor conditions has been achieved by means of a computer analysis of the melt-out process and also of the response of the electronic instrumentation. Operational problems associated with putting this equipment into service are noted. (auth)

7117 LOCATING OF FUEL ASSEMBLIES WITH DEFECTIVE FUEL ELEMENTS AFTER REACTOR SHUTDOWN. Zherebin, E. A. (State Scientific Research Inst. of Instrumentation, Moscow). pp 849-859 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Methods currently employed in nuclear power stations with boiling water and pressurized water reactors to locate fuel assemblies with defective fuel cans during refuelling operations are considered. The checking of fuel assemblies after reactor shut-down consists of: 1) sampling water from the fuel assemblies and 2) determining the reference isotope concentrations in the samples. Special attention is devoted to the question of obtaining representative water samples from the fuel assemblies. Methods of obtaining samples without extracting the fuel assemblies from the core are compared from both the technical and the operational point of view with the method of placing fuel assemblies in a "casket". (auth)

7118 GENERAL ENVIRONMENTAL SITING CRITERIA: A REVIEW OF CURRENT APPROACHES. Morrison, D. L. (Battelle Columbus Labs., OH). Trans. Amer. Nucl. Soc.; 17: 70 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7119 APPLICATION OF REGIONAL APPROACHES TO POWER-PLANT SITING. DiNunno, J.; Elkins, M. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 17: 70-71(Nov 1973).

From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7120 SYSTEMATIC DEVELOPMENT AND APPLICATION OF A COMPREHENSIVE POWER-PLANT SITE-SELECTION METHODOLOGY. Dubois, Q. B. (Florida Power Corp., St. Petersburg); Hancock, J. A.; Ohanian, M. J. Trans. Amer. Nucl. Soc.; 17: 71-72(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7121 METHODOLOGY FOR TRANSMISSION-LINE SITE SELECTION. Hulett, H. P.; Patterson, R. L. Trans. Amer. Nucl. Soc.; 17: 72-73(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7122 METHODOLOGIES FOR SELECTION OF OFFSHORE POWER-PLANT SITES. Singh, H.; Fischer, J. A. (Dames and Moore, San Francisco). Trans. Amer. Nucl. Soc.; 17: 73(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7123 NEAR-SHORE AND RIVERINE SITING OF FLOATING NUCLEAR PLANTS. Maniago, D. P. (Offshore Power Systems, Jacksonville, FL); Crandon, A. S. Trans. Amer. Nucl. Soc.; 17: 74(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7124 HEAT TRANSFER FROM A MOLTEN LAYER WITH VOLUMETRIC HEATING. Catton, I.; Clever, R. M.; Suo-Anttila, A. J. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 17: 250-251(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7125 IRRADIATED FUEL FAILURE EXPERIMENT IN A FAST REACTOR REACTIVITY ACCIDENT (TEST E6). Doerner, R. C.; Dickerman, C. E.; Rothman, A. B.; Stephenson, M. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 284(Nov 1973).
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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

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7130 ACOUSTIC DETECTION OF LOCAL CORE LMFBR ACCIDENTS. Reich, R. A.; Theofanous, T. G. (Purdue Univ., Lafayette, IN). Trans. Amer. Nucl. Soc.; 17: 288-289(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7131 ALTERNATE SHUTDOWN SYSTEM FOR THE LMFBR. McKeehan, E. R.; Shawver, B. M.; Taft, W. E. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 289-291(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7132 ANGULAR-DEPENDENT FAST REACTOR DISASSEMBLY MODELS. Bleiweis, P. B.; Kastenberg, W. E.; Okrent, D. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 17: 291-292(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7133 EFFECTS OF IODINE SPIKING ON LIGHT-WATER REACTOR ACCIDENT ANALYSIS. Pasedag, W. F. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 336(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7134 ANALYSIS OF ACCIDENTAL IODINE RELEASES FROM THE SECONDARY COOLANT SYSTEM. Fontecilla, H. M. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 336-337(Nov 1973).
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From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7136 LIQUID ENTRAINMENT RATE RELATIVE TO FISSION GAS JET IMPINGEMENT IN LMFBR SUBASSEMBLIES. Chawla, T. C.; van Erp, J. B. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 341-342(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7137 CORRELATION FOR THE HEAT TRANSFER COEFFICIENT IN THE IMPINGEMENT REGION OF A SONIC GAS JET SUBMERGED IN A LIQUID METAL, RELATIVE TO FISSION GAS JET IMPINGEMENT IN LMFBR SUBASSEMBLIES. Chawla, T. C.; van Erp, J. B.; Wilson, R. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 342-343(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7138 STRESS ANALYSIS FOR AN LMFBR FUEL PIN WITH TEMPERATURE DISTRIBUTION PERTAINING TO FISSION GAS JET IMPINGEMENT. Kennedy, J. M.; Chawla, T. C.; van Erp, J. B. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 343-344(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7139 SODIUM EXPULSION TEST IN A 7-PIN GEOMETRY. Henry, R. E.; Singer, R. M.; Lambert, G. A.; Quinn, D. J.; Spleha, E. A.; Erickson, E. G.; Jeans, W. C.; Parker, N. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 344-345(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7140 LIQUID–LIQUID FILM BOILING. Henry, R. E.; Quinn, D. J.; Spleha, E. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 345(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7141 EFFECT OF INLET BLOCKAGES IN 19-ROD SIMULATED LMFBR FUEL SUBASSEMBLIES. Fontana, M. H.; Gnadt, P. A.; Kress, T. S.; MacPherson, R. E.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 345-347(Nov 1973).
From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7142 LOCAL COOLANT FLOW DIVERSION FROM A FAILED LMFBR SUBASSEMBLY. Marr, W. W.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 347-348 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7143 AUTOCLAVE TREAT TESTS S-11 AND S-12 ON FUEL COOLANT INTERACTIONS UNDER SIMULATED CONDITIONS OF PROMPT BURST DISASSEMBLY. Zivi, S. M. (Argonne National Lab., IL); Wright, R. W.; Epstein, M.; Testa, F. J.; Goldfuss, G.; Mouring, R. W.; Barghusen, J. J.; Cho, D. H. Trans. Amer. Nucl. Soc.; 17: 349(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7144 COMPARISON OF FUEL COOLANT INTERACTION CALCULATIONS WITH THE S-11 TREAT TEST. Garner, P. L.; Erdman, C. A.; Haas, P. M.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 17: 349-351(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7145 THERMAL STRESS MECHANISM FOR THE FRAGMENTATION OF MOLTEN REACTOR MATERIALS ON CONTACT WITH COOLANT. Cronenberg, A. W.; Chawla, T. C.; Fauske, H. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 351-352(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7146 EXPERIMENTAL STUDY OF LARGE-SCALE VAPOR EXPLOSIONS. Henry, R. E.; Goldfuss, G. T.; Quinn, D. J.; Winsch, I. O. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 352-353(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7147 HEAT LOSS TO COLD STRUCTURE DURING A FUEL COOLANT INTERACTION. Chen, W. L.; Cho, D. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 353-354(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7148 FISSION GAS PLENUM CLADDING AS A HEAT SINK DURING A HYPOTHETICAL CORE DISRUPTIVE ACCIDENT (HCDA). Erdman, C. A. (Univ. of Virginia, Charlottesville); Wooldridge, L. A. Trans. Amer. Nucl. Soc.; 17: 354-355(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7149 ANALYSIS OF FUEL COOLANT INTERACTIONS BY THE IMPLICIT CONTINUOUS EULERIAN CONTAINMENT CODE. Wang, C. Y.; Bratis, J. C.; Chang, Y. W.; Fistedis, S. H. Trans. Amer. Nucl. Soc.; 17: 355-356(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7150 CLADDING MOTION MODEL FOR LMFBR-LOSS-OF-FLOW ACCIDENT ANALYSIS. Bohl, W. R.; Heames, T. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 358(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7151 FISSION GAS BEHAVIOR IN FAST REACTOR FUEL UNDER TRANSIENT POWER CONDITIONS. Dias, J. W.; Erdmann, R. C.; Okrent, D. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 17: 358-359(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7152 REACTIVITY EFFECTS OF INTERNAL MOLTEN FUEL MOTION MODELS DURING A FAST REACTOR OVERPOWER TRANSIENT. Willenberg, H. J.; Partain, W. L.; Waltar, A. E. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 359-360(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7153 FUEL SWEEPING ASSUMPTIONS IN HEDL MODEL FOR LMFBR OVERPOWER TRANSIENTS. Erdman, C. A.; Garnett, R. L.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 17: 360-361(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7154 EFFECTS OF FUEL DENSITY GRADIENTS AND MOLTEN FUEL FREEZING DURING A FAST REACTOR EXCURSION. Partain, W. L. (Westinghouse Electric Corp., Richland, WA); Waltar, A. E.; Shields, R. J. Trans. Amer. Nucl. Soc.; 17: 361-362(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7155 ENERGY RELEASE FROM MELTDOWN ACCIDENTS. Stratton, W. R.; Engle, L. B.; Peterson, D. M. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 362-363 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7156 FLECHT SYSTEMS-EFFECTS TESTS PHASE-A RESULTS. Blaisdell, J. A.; Cadek, F. F.; Hochreiter, L. E.; Suda, A. P.; Waring, J. P. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 368-369(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7157 EXPERIMENTS AND VOID CORRELATION FOR PWR SMALL BREAK LOCA CONDITIONS. Cunningham, J. P.; Yeh, H. C. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 369-370(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7158 SCALING CONSIDERATIONS OF EXPERIMENTAL POST-LOCA STEAM RELIEF. Brodrick, J. R.; Lowe, P. A.; Burchill, W. E. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 17: 370-371(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7159 PREDICTION OF SHORT-TERM BLOWDOWN TRANSIENTS. Docherty, P. J.; Bordelon, F. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 371-372 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7160 RADIATION HEAT TRANSFER RESULTS OF A LOSS-OF-COOLANT STUDY. Sutey, A. M.; Fitzsimmons, D. E. (Battelle Memorial Inst., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 372(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7161 ANALYSES OF COMPARTMENT PRESSURE TRANSIENTS FROM PIPE BREAKS OUTSIDE CONTAINMENT. Hsu, T. T.; Patti, F. J. (Burns and Roe, Inc., Hempstead, NY). Trans. Amer. Nucl. Soc.; 17: 372-373(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7162 MULTI-CELL ANALYSIS OF HIGH-ENERGY FLUID LINE BREAKS. Wattelet, P. L.; Teng, A. C. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 17: 373-374(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7163 PUBLIC DECISION MAKING ON A NUCLEAR POWER PLANT. Bachman, L. (Governor's Health Services, Harrisburg, PA). Trans. Amer. Nucl. Soc.; 17: 409(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7164 IS NUCLEAR FISSION AN ACCEPTABLE MEANS OF PRODUCING ENERGY. Abrahamson, D. E. (Univ. of Minnesota, Minneapolis). Trans. Amer. Nucl. Soc.; 17: 410-411(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7165 METHODOLOGY FOR SITE SELECTION AT THE RECONNAISSANCE LEVEL. Cordaro, M. C. (Long Island Lighting Co., Hicksville, NY); Malloy, W. T. Trans. Amer. Nucl. Soc.; 17: 413(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7166 THREE-DIMENSIONAL NEUTRONICS CALCULATIONS OF FFTF SAFETY PARAMETERS. Hardie, R. W. (Westinghouse Electric Corp., Richland, WA). Trans. Amer. Nucl. Soc.; 17: 480-481(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7167 ASSESSMENT OF RADIOLOGICAL ENVIRONMENTAL DOSES FOR RELEASES FROM LIGHT-WATER REACTORS. Kastner, J. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 17: 535-536(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7168 RADIATION DOSE DISTRIBUTIONS IN A POWER REACTOR AFTER SHUTDOWN. Simmons, G. L.; Gritzner, M. L. (JRB Associates, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 17: 560-561(Nov 1973).
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Reactor Theory and Calculation

Refer also to abstracts 6402, 6413, 6889, 7023, and 7024.

7169 (CONF-730414-P1) MATHEMATICAL MODELS AND COMPUTATIONAL TECHNIQUES FOR ANALYSIS OF NUCLEAR SYSTEMS. Proceedings of the 1973 Conference, Ann Arbor, Michigan, April 9-11, 1973. (American Nuclear Society. Michigan Section). 1973. 571p. Dep. NTIS $27.20 (2 vols.).
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
Separate abstracts are included for 28 of the 33 papers presented concerning numerical and computational aspects of transport theory, methods of fuel management analysis, thermal and hydraulic problems in reactor analysis, computer systems and software development, and mathematical and computer modeling of reactor hazards. Five of the papers have been previously indexed and included in NSA. The five papers may be located in the Report Number Index of NSA under the following: LA-UR-73-517; LA-UR-73-479; DP-MS-72-62; DP-MS-73-19; and DP-MS-72-65. (DCC)
For abstracts of individual papers see: 6864-6867, 6910, 6962, 7058-7066, 7170-7177, 7236, 7237, and 7285-7287.

7170 (CONF-730414-P1, pp I.32-I.52) PSTE: PRESENT STATUS AND FUTURE PROSPECTS. Jones, R. B. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Tavel, M. 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
In mathematical models and computational techniques for analysis of nuclear systems.
The Phase Space Time Evolution (PSTE) method is a computer simulation of the motion of points in phase space which is applicable to the solution of certain time dependent particle transport problems. In its present state of development the method is limited to one-dimensional problems, in slab or spherical geometry, in small (up to 10 mean free paths) systems. Within these limitations, whose eventual relaxation will be discussed, PSTE can simulate the motion of particles in a given scattering medium characterized by cross sections which are arbitrary functions of space and time. 12 references. (auth)

7171 (CONF-730414-P1, pp I.68-I.94) TENSORIAL ASPECTS OF POLIENERGETIC NEUTRON TRANSPORT THEORY AND CALCULATION OF SOME BASIC PARAMETERS. Boffi, V. C. (Univ., Bologna); Molinari, V.; Premuda, F.; Spiga, G.; Trombetti, T. 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
In mathematical models and computational techniques for analysis of nuclear systems.
A tensorial formulation of diffusion theory for polienergetic neutrons and calculation of some basic tensor parameters are given. This formulation is extracted from the body of the neutron linear integral Boltzmann equation by resorting to tensorial analysis techniques. Generalized tensorial derivations of Fick's law and of diffusion equation, improving the corresponding results of the usual "scalar" polienergetic diffusion theory, are presented for the case of a homogeneous finite body. Previous results for the tensor diffusion coefficient in the monoenergetic case are imbedded in a more general frame, and numerical calculations are reported for some tensor parameters which describe the anisotropic character of neutron diffusion both in the slowing down and thermal energy ranges. 9 references. (auth)

7172 (CONF-730414-P1, pp. I.95-I.112) APOLLO: A GENERAL CODE FOR TRANSPORT, SLOWING-DOWN AND THERMALIZATION CALCULATIONS IN HETEROGENEOUS MEDIA. Kavenoky, A. (Centre d'Etudes Nucleaires, Saclay, France). 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
In mathematical models and computational techniques for analysis of nuclear systems.
APOLLO calculates the space-and-energy-dependent flux for a one dimensional medium, in the multigroup approximation of the transport equation. For a one dimensional medium, refined collision probabilities have been developed for the resolution of the integral form of the transport equation; these collision probabilities increase accuracy and save computing time. The interaction between a few cells can also be treated by the multicell option of APOLLO. The diffusion coefficient and the material buckling can be computed in the various B and P approximations with a linearly anisotropic scattering law, even in the thermal range of the spectrum. Eventually this coefficient is corrected for streaming by use of Benoist's theory. The self-shielding of the heavy isotopes is treated by a new and accurate technique which preserves the reaction rates of the fundamental fine structure flux. APOLLO can perform a depletion calculation for one cell, a group of cells or a complete reactor. The results of an APOLLO calculation are the space-and-energy-dependent flux, the material buckling or any reaction rate; these results can also be macroscopic cross sections used as input data for a 2D or 3D depletion and diffusion code in reactor geometry. 10 references. (auth)

7173 (CONF-730414-P1, pp IV.11-IV.16) RSYST: AN INTEGRATED MODULAR SYSTEM FOR REACTOR AND SHIELDING CALCULATIONS. Ruehle, R. (Univ., Stuttgart). 1973.
From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).
In mathematical models and computational techniques for analysis of nuclear systems.
RSYST is an integrated modular system which helps to deal with reactor and shielding calculations in a simple way. The data kept in its data base are organized in data blocks containing the physical information. Each block contains also a description of the structure of its data. Therefore it may be interpreted separately. Each module of the system may generate or access these blocks in a flexible way determined by the user's input. In addition to the data blocks, a hierarchical description of the physical or project context of the blocks is stored on the data base. By this the user may formulate together with a syntax oriented input description, any module sequence to solve his problems. Presently shielding, reactor physics and burnup modules are implemented in RSYST. 4 references. (auth)

7174 (CONF-730414-P1, pp IV.17-IV.33) DATATRAN DESIGN AND EXPERIENCE. Kopp, H. J.; Schilling, W. E.; Selengut, D. S.; Stieglitz, R. G. (Knolls Atomic Power Lab., Schenectady, NY). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

DATATRAN has been developed to provide a syntax-oriented data management system designed for a modular computer program network. DATATRAN statements are compatible with FORTRAN and supplement FORTRAN input/output features. Over six years of KAPL experience has demonstrated that input preparers, scientists and engineers, and programmers can effectively use the system to achieve their work objectives. This KAPL experience was obtained from well over 100,000 jobs which spanned many technical and administrative disciplines. Specific improvements have been achieved by a joint KAPL-Bettis effort in the areas of efficiency, increased central memory allocation for application modules, compatibility with existing programs, reduced system maintenance, and reduced machine dependence. Fundamental design considerations that have led to improved performance are discussed. (auth)

7175 (CONF-730414-P1, pp IV.46-IV.58) HARDWARE MONITOR VIEW OF REACTOR PROBLEMS. Butler, M. K. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The Neurotron hardware monitor was used to collect instruction count statistics and related machine performance data for reactor problems included in the Argonne National Laboratory benchmark problem collection. These measurements, made during IBM 360/75 execution, were studied to determine similarity of individual problems, and a Euclidean metric was applied in an attempt to identify job clusters with like attributes. 6 references. (auth)

7176 (CONF-730414-P1, pp IV.59-IV.74) LINKED SYSTEM OF REACTOR PHYSICS CODES BASED ON STANDARD INTERFACES. Vigil, J. C.; Carmichael, B. M. (Los Alamos Scientific Lab., NM). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Selected reactor physics codes have been linked by a set of interface data files specified by the de facto Committee on Computer Code Coordination. These codes collectively provide capabilities for cross-section processing; one- and two-dimensional transport and diffusion theory calculations; one-, two-, and three-dimensional perturbation calculations; and fuel depletion calculations. Access to the interfaced codes, free-format card input for creating or modifying the interface files, file transfer to and from permanent storage, and file printing are available at any point in whatever calculation path the user chooses to prescribe. The present system of codes represents only an interim development. A second generation of standard interfaces has been specified and the system is presently being adapted to these new interfaces. Other more advanced codes are also being adapted to the new interfaces and will be tested as components of the system. 26 references. (auth)

7177 (CONF-730414-P1, pp IV.75-IV.85) IBM 360 TO CDC 6000/7000 CODE CONVERSION PACKAGE. Woodruff, W. L.; Lee, R. H. (Argonne National Lab., IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A collection of CDC Fortran and Compass routines has been developed for code conversion from IBM 360 to CDC 6000/7000 system. These routines interface with standard CDC software to provide capabilities similar to those available on an IBM system. With this package, up to 64 levels of overlay with multiple entry points and parameters can be supported, the IBM form of subprogram entry points can be handled, I/O buffers can be dynamically allocated as needed, and most other minor Fortran differences can be resolved. Thus, CDC compatible code can be produced with only a few simple Fortran modifications required. 7 references. (auth)

7178 (CONF-730414-P2) MATHEMATICAL MODELS AND COMPUTATIONAL TECHNIQUES FOR ANALYSIS OF NUCLEAR SYSTEMS. Proceedings of the 1973 Conference, Ann Arbor, Michigan, April 9–11, 1973. (American Nuclear Society. Michigan Section). 1973. 564p. Dep. NTIS $27.20 (2 Vols.).

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Separate abstracts are included for 24 of the 27 papers presented concerning methods of optimization for reactor systems, multidimensional reactor statics, nuclear applications of hybrid and process control computers, and multidimensional reactor dynamics. Three of the papers have been previously indexed and included in NSA. The three papers may be located in the Report Number Index of NSA under the following: DP-MS-72-64; DP-MS-73-17; and DP-MS-72-63. (DCC)

For abstracts of individual papers see: 6701, 6842, 6907, 6911, 6912, 7067, 7179–7189, 7238–7241, 7283, 7288, and 7289.

7179 (CONF-730414-P2, pp VI.1-VI.37) SURVEY OF OPTIMIZATION TECHNIQUES FOR NUCLEAR REACTOR SYSTEMS. Larson, R. E. (Systems Control, Inc., Palo Alto, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A survey is presented of optimization techniques that are applicable to nuclear reactor systems. A tutorial description of the most widely used methods is included. The references give further details on these methods. Specific problems where the techniques have been applied are discussed. 26 references. (auth)

7180 (CONF-730414-P2, pp VII.1-VII.6) CURRENT PROBLEMS IN MULTIDIMENSIONAL REACTOR CALCULATIONS. Froehlich, R. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The discussion of multidimensional reactor calculations is restricted to static problems. It is attempted to place the current mathematical and computational methods development efforts into an appropriate perspective by giving a short review about the accuracy requirements and present capabilities of predicting physical parameters for fast and thermal reactors. The mathematical properties of the transport and diffusion equations and of their exact solutions are considered and their relevance to the development of numerical methods is sketched. The theoretical foundation of numerical solution methods is discussed. Typical computational difficulties based on characteristic physics properties of various reactor types are presented and the benefits, difficulties, and the reliability of several computational methods are reviewed. In addition, new methods and possible future trends are discussed. Finally some of the outstanding mathematical and computational problems for fast and thermal power reactor calculations are mentioned. 131 references. (auth)

7181 (CONF-730414-P2, pp VII.67-VII.94) MATHEMATICAL AND COMPUTATIONAL PROBLEMS IN REACTOR CALCULATIONS. Babuska, I.; Kellogg, R. B. (Univ. of Maryland, College Park). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Two computational problems connected with the solution of the neutron diffusion equation and neutron transport equation are considered. The first problem, called the local problem arises from the presence of material interfaces and their effect on the differentiability of the solution. The second problem, called the global problem concerns lattice geometries and the use of homogenization procedures. For both problems there is given an informal discussion of the mathematical situation and of some numerical experiments. 19 references. (auth)

7182 (CONF-730414-P2, pp VII.95-VII.119) COMPARISON OF EXTRAPOLATION TECHNIQUES WITH HIGH ORDER FINITE ELEMENT METHODS FOR DIFFUSION EQUATIONS WITH PIECEWISE CONTINUOUS MATERIAL PROPERTIES. Hennart, J. P. (Instituto Politecnico Nacional, Mexico City). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

An alternative method to the use of high-order finite element methods is presented for solving multigroup diffusion equations with piecewise continuous material properties. Based on extrapolation of low-order finite element approximations, this method is shown to be much more suited to highly heterogeneous problems than high-order finite elements: numbers of unknowns as well as calculation times are reduced while the effect of the singularities on the convergence rate is minimized. Comparisons with classical finite differences and estimations of savings are very promising especially for the calculation of thermal water reactors. 23 references. (auth)

7183 (CONF-730414-P2, pp VII.120-VII.135) EFFECT OF WEIGHTING FUNCTIONS ON THE COARSE MESH REBALANCING ACCELERATION. Nakamura, S. (Ohio State Univ., Columbus). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Effect of the weighting functions of coarse mesh rebalancing on the acceleration of iterative solution of large linear systems is mathematically studied. It is assumed that the linear operator is a non-singular and positive definite matrix. Five types of weighting vectors are considered: the least square method, the Galerkin method, the moment method and two types of weighting vectors which are obtained by operating the iterative matrix to the trial vectors. It is concluded that the moment method has higher potential of accelerating convergence of iterative solutions than the least square method and the Galerkin method. 11 references. (auth)

7184 (CONF-730414-P2, pp VII.136-VII.161) PHYSICS ASSUMPTIONS AND APPLICATIONS OF COLLISION PROBABILITY METHODS. Emendoerfer, D. (Univ., Stuttgart). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Starting from the integral transport equation, the neutron balance relations for different collision probability concepts are derived. Consequences of approximations in the spatial distribution of the source density as well as in the angular distribution of currents at interfaces are discussed from a physical point of view. In addition to the classical application of collision probability methods to reaction rate calculations in lattices, the multidimensional overall reactor calculation by collision probability methods is reviewed. Techniques for the evaluation of the respective transmission- escape- and collision probabilities are presented. 20 references. (auth)

7185 (CONF-730414-P2, pp VII.162-VII.178) PARTIAL CURRENT BALANCE METHOD FOR SPACE-, AND ENERGY-DEPENDENT REACTOR CALCULATIONS. Burns, T. J.; Dorning, J. J. (Univ. of Illinois, Urbana). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

An approximation procedure is developed for the solution of the space-dependent multigroup reactor statics and reactor dynamics equations. The nuclear system is partitioned, a Green's function is used to eliminate the spatial differential operators in the equations for each element, and continuity of partial currents is imposed to maintain a neutron balance. Expansion of the space-dependence of the flux results in a set of integro-differential equations in time (for the dynamics case). Because the Green's function is the exact solution for part of the neutron migration operator involved, this technique results in fewer equations than most conventional techniques for given accuracy (an important advantage, particularly when treating the stiff equations arising in reactor dynamics). Reactor statics calculations performed using both the above method and ordinary finite difference methods are presented and compared. 24 references. (auth)

7186 (CONF-730414-P2, pp VII.195-VII.201) SPECTRAL FLUX SYNTHESIS IN MULTI-DIMENSIONAL PROBLEMS USING SPATIALLY DISCONTINUOUS TRIAL FUNCTIONS. Olson, W. O.; Robinson, A. H. (Oregon State Univ., Eugene). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

One and two dimensional diffusion theory codes have been written to accommodate a very general formulation of the spectral synthesis (overlapping group) method. These codes use simultaneous solution methods to eliminate many convergence problems previously encountered and allow a variety of interface conditions. Numerical experiments with these codes compare several types of weighting using spatially continuous and discontinuous trial functions, with particular attention to material and trial function interface conditions. The results favor interface conditions which preserve energy integrals of flux and current, with a resultant bias toward group weighting. 8 references. (auth)

7187 (CONF-730414-P2, pp VII.202-VII.224) KAPER: A COMPUTER PROGRAM FOR THE ANALYSIS OF EXPERIMENTS PERFORMED IN HETEROGENEOUS CRITICAL FACILITIES. McGrath, P. E.; Fischer, E. A. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The essential features of the methods employed to calculate effective multigroup self-shielded cross sections, flux and reaction rate distributions, and reactivity worths in a heterogeneous cell are presented. The methods are based on a heterogeneous formulation of the self-shielding factor (f-factor) concept in the integral transport theory equation. Representative numerical results are included and compared to experiments. 10 references. (auth)

7188 (CONF-730414-P2, pp VIII.58-VIII.64) STATE OF THE ART OF HYBRID COMPUTER APPLICATIONS IN THE NUCLEAR INDUSTRY. Vichnevetsky, R. (The State Univ. of New Jersey, Rutgers). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Attempting to report on the "state of the art" of hybrid computer applications in the nuclear industry is a particularly difficult task. The typical "scenario" for such reports has been, for several years, one of enunciating the differences between digital and analog/hybrid machines, and then to list several case studies in which it has been proven, more or less conclusively, that modern hybrid computers have the potential to be at least one, and more likely several orders of magnitude more economical than modern digital computers in the simulation of large scale nuclear power plants. 60 references. (auth)

7189 (CONF-730414-P2, pp IX.15-IX.30) FINITE MEDIUM DISPERSION FORMALISMS FOR THE CALCULATION OF TRANSIENT PHENOMENA IN FAST MULTIPLYING ASSEMBLIES. Dorning, J.; Kraft, T. (Univ. of Illinois, Urbana). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Two generalized dispersion formalisms are developed for the time-response following a neutron pulse in a bounded fast multiplying assembly. One formalism is restricted to transport theory since it is developed using the finite medium streaming operator. The other applies equally well to the transport theory and diffusion theory descriptions of the neutron population. In both formalisms the Laplace and Fourier transformed fission source is shown to satisfy a linear integral equation in one variable. The methods are presented in the context of energy-dependent transport theory. Simplifications which result from restricting the formalism to one-speed transport theory are pointed out. Solution methods for the fission source in specified geometries are discussed. 30 references. (auth)

7190 (CONF-731015-1) UTILIZATION OF INTEGRAL EXPERIMENTS AND RELATED DATA IN LMFBR DESIGNS. Dyos, M. W.; Paik, N. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(11-1)-3045. 22p. Dep. NTIS $3.25.

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973).

Detailed analyses of plate versus pin measurements of reactivity, sodium void, reaction rate ratio, and doppler effect are presented. The measurements were performed in pin and plate environments of nearly identical composition in ZPPR-2 and

ZPR-6-7. An improved capability for calculating plate versus pin effects will improve the applicability of plate critical assembly data in LMFBR design. (JWR)

7191 (EANDC(E)-154(U), pp 1-11) REQUESTS ON THE KNOWLEDGE OF $\bar{\nu}$ FOR REACTOR PHYSICS. Barre, J. Y.; Reuss, P. Mar 1973.

From 16th EANDC topical conference; Saclay, France (29 Nov 1972).

The sensitivities of design parameters to $\bar{\nu}$ values are considered for fast and thermal neutron reactors. This analysis is divided into three parts; influence of the absolute value of $\bar{\nu}$ for standard isotope at thermal energy, relative variation of $\bar{\nu}$ with energy, relative value between two isotopes. The interpretation of integral experiments performed to improve the neutron balance leads also to $\bar{\nu}$ values with a good accuracy. The consequences of inaccuracies on $\bar{\nu}$ for some conclusions drawn from these integral experiments are presented. Finally, the current values of $\bar{\nu}$ used for the main fissile isotopes and the accuracies needed for either thermal or fast reactors are presented. (auth)

7192 (EUR-5031) RINA: A COMPUTER CODE FOR THE RUNNING IN EVALUATION. Graziani, G.; Paruccini, M. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Oct 1973. 48p. Dep. NTIS (U.S. Sales Only) $4.50. EUR B.Fr. 60.-.

A 1-dimensional computer program is described which calculates the approach to equilibrium cycle for thermal reactors with a partial refueling scheme. The assumptions made in the calculation method have the effect of strongly reducing the computer time, which, together with the flexibility of the input, makes the use of the code particularly suitable for survey investigations. (auth)

7193 (MRR-83) DIGITAL PREPARATION OF A SYSTEM OF EQUATIONS FOR THE ANALOG COMPUTER (SKALP 4004). Koeberlein, K. (Technische Univ. Munich (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). Nov 1970. 27p. INIS.

A digital program SKALP is developed in order to spare users of analog computers the unnecessary trouble of preparing equations for an analog computer. The input specifications and output facilities of SKALP are described. The programming language chosen is ALGOL to allow SKALP to be used on various computers. The version described is used on a SIEMENS 4004/55 computer. The preparation of the equations for the neutron flux of a nuclear reactor with temperature-dependent reactivity is given as an example. (EB)

7194 (RT/ING-(73)1) TRANSIENT TEMPERATURE DISTRIBUTION OF A POWER REACTOR FUEL ELEMENT. Forghieri, R.; Orru, G.; Papa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 7 Feb 1973. 19p. (CONF-710903-34). Dep. NTIS $3.00.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A mathematical model for the dynamic heat transfer of a power reactor with a cylindrical type fuel element is presented. The cylindrical fuel element is composed of a hollow fuel core and its cladding separated by a vacuum gap: these two regions are supposed homogeneous and isotropic with thermal properties independent from the temperature. The mathematical model is based on heat diffusion equations in fuel and cladding with radiative heat transfer in the vacuum gap between them and on the convection equation for the coolant fluid. (auth)

7195 REVIEW OF MEASUREMENT TECHNIQUES FOR DYNAMIC CHARACTERISTICS. Uhrig, R. E. (Univ. of Florida, Gainesville). pp 339-342 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Comprehensive studies of the dynamic behavior of nuclear power plants have been undertaken for many years and have clearly established that noise techniques are comparable to oscillator tests and appropriate for the use on power reactors. Several reactor manufacturers have worked primarily on the use of noise analysis techniques. However, results of reactor noise measurements are not yet well understood for nuclear power plant operation. One of the major obstacles to a comprehensive program of reactor dynamics measurements has been the complexity of the measurement procedure. Also, the acquisition and procession of data can be quite complex. In recent years, the use of pseudorandom binary input signals has been very attractive because its principal advantage is in the processing of the data. However, the potential development of noise analysis in nuclear power systems is being hindered by other non-technical problems. (auth)

7196 PLANNING, PERFORMING, AND INTERPRETING FREQUENCY RESPONSE TESTS ON POWER REACTORS. Kerlin, T. W. (Univ. of Tennessee, Knoxville). pp 343-357 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Dynamic tests on nuclear power reactors can provide useful information on system performance and safety that is difficult or impossible to obtain in steady-state tests. The value of these tests is enhanced by planning, performing and interpreting them efficiently. The technology for all three phases of a frequency response test program has advanced to the point that the benefits fully justify the routine use of these tests in commercial power reactors. (auth)

7197 NOISE ANALYSIS AND PSEUDOSTOCHASTIC PERTURBATION TECHNIQUES FOR REACTOR PARAMETER ESTIMATION. Kolb, M.; Raschti, M. A.; Robinson, E.; Weber, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). pp 359-371 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Noise analysis and pseudostochastic perturbation techniques are presented which were applied to the swimming-pool-type research reactor FRG and the self-pressurized water reactor FDR of the nuclear ship "Otto Hahn". Noise techniques were chosen as one part of the investigation of the FDR system to measure the correlation between random fluctuations of acceleration in the reactor compartment owing to rolling and pitching of the ship and neutron fluctuation spectra. These correlations are induced by pressure variations in the FDR and may also be influenced by vibrations of control rods. A technique to analyze non-linear random effects was developed, especially to study the control-rod vibrations. The complexity of the distribution of noise sources in the FDR system made it difficult to estimate reactor parameters from power noise spectra. A pseudostochastic perturbation technique was therefore developed to modulate the reactivity balance in a reproducible way by control-rod movements. This technique was first implemented and tested at the FRG with pseudostochastic binary sequences and then applied to the FDR. The power reactivity coefficient of the FRG and the power-, temperature- and pressure coefficients of the FDR were estimated from the measured cross-power spectral densities. At the ship reactor a modified binary signal (inverse repeat binary) to discriminate against non-linear effects was also applied. (auth)

7198 REFLECTOR EFFECT ON NEUTRON WAVE PROPAGATION IN MULTIPLYING MEDIA. Shani, G. (Univ. of Negev, Beer-Sheva, Israel). Nucl. Sci. Eng.; 52: No. 2, 215-226(Oct 1973).

Neutron waves in a reflected reactor are analyzed using the two-group diffusion equation. The solution is composed of a transient which disappears within a few milliseconds, a steady-state part, and an oscillatory part. The last is comprised of four terms corresponding to four waves: two propagating waves and two reflected waves. When a sinusoidal source of thermal neutrons is applied to a water-moderated multiplying medium, the source wave amplitude decays with a relaxation length equal to the diffusion length of the medium. A wave of fast neutrons is then produced by fission which is induced by the source wave. This fast-neutron wave carries the wave phenomenon across the core. The two propagating thermal-neutron waves are (a) the source wave, and (b) a wave of thermalized fission neutrons. The two reflected waves are the reflections of the two propagating waves. The amplitudes and phases of the four waves are calculated, together with those of the total wave which is the sum of the four partial waves. The agreement of the measured data of the total wave with the calculations is reasonable. Modulated poison and source oscillators were used for the experiments. The reactor response to both was essentially the same except in the region near the oscillators; while the first decreased the number of neutrons, the second increased their number. (auth)

7199 DISCREPANCY BETWEEN MEASURED AND CALCULATED CENTRAL REACTIVITY COEFFICIENTS. Karam, R. A. (Georgia Inst. of Tech., Atlanta); Kato, W.Y. Nucl. Sci. Eng.; 52: No. 2, 201-208(Oct 1973).

Systematic errors responsible for the large discrepancy between the measured and calculated central reactivity coefficients were

examined. These errors were narrowed to two sources: the normalization integral (or perturbation denominator) and the conversion factor of inhour, or dollars, to $\Delta k/k$ units. The magnitude of both sources of error is uniquely determined by the ratio of the measured-to-calculated normalization integral when the measurement is carried out using the ^{252}Cf source-reactivity method. The measured-to-calculated normalization integral ratios for ZPR-6 Assemblies 6A and 7, two typical demo-plant-size Liquid Metal Fast Breeder Reactor criticals, were 1.19 and 1.21, respectively. The magnitude of this discrepancy is essentially the same as that found for the central reactivity coefficient. Analysis of the available fission rate distribution in both assemblies indicates that the calculated normalization integral may be underestimated by 6 to 8% and that the remainder of 10 to 14% must come from the conversion factor. The delayed-neutron data of Krick and Evans, when used with the appropriate average number of neutrons per fission in each assembly, yield conversion factors 9 to 13% higher than the delayed-neutron data of Keepin. This would provide the explanation of the central reactivity discrepancy. Unfortunately, the method of calculating β_{eff} could also produce errors of this magnitude even if one has an absolutely correct set of delayed-neutron fractions. More definitive measurements of the delayed-neutron fractions of pertinent isotopes, as a function of the incident neutron energy, are needed. In addition, measurements of β_{eff} in various assemblies by different methods are required. (auth)

7200 MEASUREMENTS OF FAST-NEUTRON SPECTRA IN REACTOR SHIELDS. Livengood, C. D. (Northwestern Univ., Evanston, IL); Paulson, C. K.; Hungerford, H. E. Nucl. Sci. Eng.; 52: No. 2, 254-266(Oct 1973).

Experimental techniques previously used for measuring neutron spectra in fast critical assemblies have been applied to reactor shielding problems. Fast-neutron spectra in the energy range from 25 keV to 1 MeV have been measured in the water shield surrounding a small thermal research reactor. Three different water thicknesses were investigated, as well as a combination of water with a 2-in.-thick slab of iron. The spectrometer system developed for these measurements employs small proton-recoil proportional counters, together with electronic pulse-shape discrimination for the rejection of gamma-ray signals. Since this discrimination is extremely important for shielding measurements, the detectors and electronic system are described in some detail. The basic theory underlying proton-recoil measurements of neutron spectra is reviewed, as well as the techniques used to correct for errors arising due to finite detector size and irregularities in the electric field within the counters. Results of the water measurements indicate that the spectrometer is capable of measuring the absolute neutron flux as well as relative variations within the spectrum at a given point. In addition, predictions of spectral hardening with increasing water thickness are verified. The water-iron measurements indicate that the system is capable of measuring spectral features caused by resonances in the cross section of the shield material. (auth)

7201 OPTIMAL ESTIMATION FOR SPACE-TIME REACTOR PROCESSES. Maslowski, A. (Warsaw Technical Univ.). Nucl. Sci. Eng.; 52: No. 2, 274-278(Oct 1973).

The problem of optimal estimation of state for deterministic space-time reactor processes has been considered. Based on the proposed dynamic and observation models and the quality index, the problem of estimation has been formulated. The conditions of the optimal solution have been given using the theory of Lagrange functionals. Analytical and numerical solutions of power density estimation in the slab reactor are presented. (auth)

7202 GENERALIZED DIFFUSION THEORY FOR THE COMPUTATION OF THE TRANSPORT SCALAR FLUX. Alcouffe, R. E. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 17: 229(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7203 NINE-POINT DIFFERENCE APPROXIMATION TO THE LAPLACIAN OPERATOR. Rohach, A. F. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 17: 232-233(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7204 NUMERICAL MODEL FOR NUCLEAR CORE THERMAL-HYDRAULIC ANALYSIS. Rowe, D. S. (Battelle-Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 17: 242-243(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7205 RESPONSE-MATRIX METHOD FOR SPACE-DEPENDENT NUCLEAR REACTOR KINETICS CALCULATIONS. Sicilian, J. M.; Leonard, A. (Stanford Univ., CA). Trans. Amer. Nucl. Soc.; 17: 252(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7206 OPERATOR SPLITTING FOR SPACE-DEPENDENT KINETICS. Devooght, J.; Mund, E.; Van Vliet, J.; Van Wylick, J. (Univ. Libre, Brussels). Trans. Amer. Nucl. Soc.; 17: 253(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7207 HIGH-ORDER METHOD FOR TWO-DIMENSIONAL SPACE-TIME KINETICS PROBLEMS. Dubois, G. (Ecole Polytechnique, Montreal). Trans. Amer. Nucl. Soc.; 17: 253-254(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7208 DIRECT ITERATIVE CALCULATION OF TRANSIENT NEUTRON FLUX STATES FOR 3-D HEXAGONAL LATTICES. Stewart, J. W.; Buckner, M. R. (E. I. Du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 255(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7209 RESPONSE MATRIX METHOD AND THE COSINE-CURRENTS APPROXIMATION. Pryor, R. J. (E. I. Du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 17: 262(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7210 HIGH-TEMPERATURE DOPPLER MEASUREMENT USING THE PULSED ACTIVATION TECHNIQUE. Bhattacharyya, S. K.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 461-462(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7211 ANALYSIS OF TRX LATTICES WITH ENDF/B-III DATA. Hardy, J. Jr. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 17: 468-469(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7212 ESTIMATION OF REACTIVITY WORTHS BY LOCAL CALCULATION. Lineberry, M. J.; McFarlane, H. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 472(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7213 ACCURACY OF POINT KINETICS. Apostolakis, G. E. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 17: 476-477(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7214 SENSITIVITY ANALYSIS OF THE INVERSE KINETICS ROD-DROP TECHNIQUE. Allen, J. W. (Univ. of Tennessee, Knoxville); Robinson, J. C.; Ackermann, N. J. Jr. Trans. Amer. Nucl. Soc.; 17: 477-478(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7215 DETERMINATION OF REACTIVITY FROM NOISE DATA. Wang, H. K.; Ruby, L. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 17: 479-480(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7216 REACTIVITY EFFECTS DUE TO MAGNETIC SCATTERING OF THERMAL NEUTRONS BY MAGNETIZED IRON.

Battista, U.; Franco, F.; Maggioni, A.; Pedretti, E. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 17: 493-494(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7217 APPLICATIONS OF OBSERVATIONAL KINETICS IN POWER REACTOR STARTUP AND OPERATIONS. Impink, A. J. Jr.; Poncelet, C. G. (Carnegie-Mellon Univ., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 503-504(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Reactor Components and Accessories

Refer also to abstracts 5017, 5031, 5033, 5436, 5463, 5504, 5523, 5525–5527, 5538, 5548, 5553–5559, and 5643.

7218 (CEA-Bib-205) ACOUSTIC TECHNIQUES IN REACTORS SURVEILLANCE. Le Levier, M. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Oct 1973. 51p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

This bibliography deals with 120 references selected from volumes 25 and 26 of Nuclear Science Abstracts (1971–1972). An author index and a subject index are included. (auth)

7219 (NRL-7603) GENERALIZED PROCEDURES FOR THE USE OF PLANE STRAIN AND ELASTIC-PLASTIC FRACTURE MECHANICS OPTIONS IN THE MODERNIZATION OF NUCLEAR STANDARDS. Loss, F. J.; Hawthorne, J. R.; Pellini, W. S. (Naval Research Lab., Washington, D. C. (USA)). 27 Apr 1973. 27p.

In the design of nuclear power plants and the selection of required structural materials, the assurance of reliability in operation is an essential consideration. The need for analytical criteria for defining the adequacy of fracture toughness specifications is particularly acute for pressure vessel materials. Recent developments in the means for defining the full range of plane strain, elastic-plastic, and plastic fracture mechanics options available to the designer are described. Comparisons are made between these options and the fracture toughness requirements of the ASME Nuclear Code (Section III). Existing dynamic plane strain (K_{Id}) data for structural metals are analyzed in concert with dynamic tear (DT) test trends. The limited temperature region of K_{Id} applicability for these materials is shown to presage the elastic-plastic regime, through which sharply increasing stress is required for fracture propagation until a leak-before-fail condition is ultimately attained. This phenomenon highlights the need to extend the analytical capabilities for fracture assurance into the nonbrittle regime. The DT test is an effective engineering tool which, like the crack-opening displacement (COD) concept, can be used to define the elastic-plastic and plastic constraint transitions. The DT test procedure is fully rationalizable in terms of section size parameters and can be used independently, or together with the K_{Id}-temperature trend, to predict the onset of the elastic-plastic and plastic regimes as a function of temperature and section thickness. (auth)

7220 (RDT-E-8-19-T(10-73)) OPEN TEST ASSEMBLY FABRICATION. (USAEC Division of Reactor Research and Development, Washington, D.C.). Oct 1973. 13p. RSO.

The requirements for the manufacture of certain parts for Open Test Assemblies (OTA), formation of subassemblies, and assembly of complete OTA's are established. This standard does not apply to the manufacture of irradiation test instrumentation and subassemblies, the test duct containing the test subassembly, the orifice shield and nozzle assembly, and associated reactor instrumentation which are parts of a completed OTA. (auth)

7221 FREE VIBRATION OF AN ELASTIC MEDIUM CARRYING DISCRETE MASSES. Wu, T. T.; Raju, P. P. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 17: 256-257(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7222 BACKWASHING A STACKED DISK FILTER. van den Berg, T.; Lancey, T. W. (Vacco Industries, El Monte, CA). Trans. Amer. Nucl. Soc.; 17: 322(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7223 NUCLEAR POWER PLANT NOISE MONITORING. Robinson, J. C.; Mott, J. E. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc.; 17: 376-377(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7224 ORNL HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS DEVELOPMENT PROGRAM. Greenstreet, W. L. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 400(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7225 ORNL DESIGN CRITERIA PROGRAM FOR PIPING SYSTEM COMPONENTS. Moore, S. E. (Oak Ridge National Lab., TN); Rodabaugh, E. C. Trans. Amer. Nucl. Soc.; 17: 400-401(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7226 SUMMARY REPORT ON THE EEI RP 79 PROGRAM. Reinhart, E. R. (Southwest Research Inst., San Antonio). Trans. Amer. Nucl. Soc.; 17: 403-404(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Reactor Fuels

Refer also to abstracts 5058, 5094, 5249, 5397, 5404, 5413, 5414, 5425–5427, 5429–5434, 5449, 5450, 5537, 5551, 5552, and 5560.

7227 (ANCR-1124) THEORETICAL BASIS FOR CALCULATING DIFFUSION OF FISSION PRODUCTS IN FUEL PINS. McMurry, H. L. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Aug 1973. Contract AT(10-1)-1375. 28p. Dep. NTIS $4.00.

Ambiguities in the theory for the diffusion of atoms in media where concentration gradients and temperature gradients exist simultaneously are reviewed. The necessity to calculate the diffusion of fission products in fuel pins is discussed. The literature contained a number of different recipes for the way the temperature gradient and the concentration gradient were to be combined to produce the proper "driving force" for diffusion. In addition, some writers appeared to be inconsistent in the way they applied the theory, and others omitted so much theory that the origins of their equations were difficult to establish. The application of the theory of steady state, non-equilibrium thermodynamics to determine the correct form for the equations of coupled heat and mass flow is traced. The form of the equation for atom diffusion is then identified. An appendix gives more complete details of the derivations. (auth)

7228 TECHNIQUES AND EQUIPMENT FOR FUEL EXAMINATIONS AT POWER REACTOR SITES. Ogawa, S. Y.; Lyons, M. F.; Soulis, R. E. (General Electric Co., San Jose, CA). Conf. Remote Syst. Technol., Proc.; No. 21, 104-108(1973).

From 21st conference on remote systems technology; San Francisco, California, USA (11 Nov 1973). See CONF-731111-.

Steady improvement in the techniques and equipment available for underwater testing and examination at power reactor site pools has increased the accuracy and reliability of information obtained on the performance of nuclear fuel elements. New developments coming into use will result in increased sensitivity and resolution capabilities, faster operation, and improved portability in such areas as leak testing, bundle handling and repair, visual inspection, nondestructive testing by pulse eddy-current and ultrasonic methods, dimensional measurements, and rod puncturing and shearing. An overall view of site fuel examination activities is presented. (auth)

7229 IN-PILE MEASUREMENT OF FUEL CLADDING CONDUCTANCE FOR PELLETED AND VIPAC ZIRCALOY-2 SHEATED FUEL PINS. Calza Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U.; Rotoloni, P. L. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 17: 166(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7230 PREDICTING IN-REACTOR DENSIFICATION BEHAVIOR OF UO_2. Marlowe, M. O. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 17: 166-169(Nov 1973).

From joint meeting of the American Nuclear Society and the

Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7231 BUBL-2: A STATISTICAL FUEL SWELLING AND GAS RELEASE MODEL FOR VARYING POWER HISTORY. Warner, H. R.; Nichols, F. A. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 17: 181-182(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7232 FISSION GAS BEHAVIOR IN A MILD OVERPOWER TRANSIENT. Stahl, D. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 183-184(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7233 FAILURE PREDICTION OF CLADDING UNDER INTERNAL PRESSURES AT ELEVATED TEMPERATURES. Wang, P. Y.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 17: 397-398(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7234 SELF-SHIELDING EFFECT IN FUEL ASSEMBLY GAMMA SCANNING. Gualandi, M. P.; Peroni, P. (ENEL-DCO, Rome). Trans. Amer. Nucl. Soc.; 17: 474-475(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Reactor Control Systems

Refer also to abstract 7131.

7235 (AI-AEC-13078) ZIRCONIUM HYDRIDE REACTOR CONTROL REFLECTOR SYSTEM: SUMMARY REPORT. Horton, P. H.; Kurzeka, W. J. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1972. Contract AT(04-3)-701. 158p. Dep. NTIS $7.60.

The beryllium reflector control system development for SNAP reactors is documented, from the initial SNAP 10A System through the current 5-kW(e) Thermoelectric System. Described are the various reflector concepts used in these systems for shadow-shielded and 4π-shielded nuclear systems. The development of the key components, such as the actuators, bearings, and drive mechanisms for these systems, is also traced from the SNAP 10A concept through to the current system. Developmental test results are outlined, showing the performance capability improvements made throughout the life of the SNAP programs. Component development was highly successful, as proven by a number of reactor systems tests, including the launch and operation of the SNAP 10A flight. 46 references. (auth)

7236 (CONF-730414-P1, pp II.56-II.88) OPTIMAL CONTROL ROD POLICIES FOR AN OPERATING CYCLE OF A SIMULATED BOILING WATER REACTOR CORE. Snyder, B.; Lewis, E. E. (Northwestern Univ., Evanston, IL). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Forward dynamic programming is used to optimize two-rod-bank withdrawal policies for a large boiling water reactor. The method permits large numbers of optimal control problems to be solved efficiently and simultaneously. As a result more information about the structure of the problem is obtained than would be possible using local optimization techniques. The core is represented by an infinite lattice with the axial power and void distributions modeled by consistent power-void profiles, and the axial burnup state modeled by a three-term Fourier series. Optimal policies are based on power peaking criteria; these are found to vary greatly with different rod withdrawal policies and to change drastically with increasing burnup. 27 references. (auth)

7237 (CONF-730414-P1, pp II.89-II.112) CONTROL EIGENVECTOR EXPANSION TECHNIQUE FOR FINDING THE OPTIMUM OBTAINABLE POWER DISTRIBUTION. Long, S. M.; Dalton, G. R. (Univ. of Florida, Gainesville). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A method is presented for locating an optimum power distribution using multigroup diffusion theory. A poison with arbitrary $\sigma_a(E)$ at an arbitrarily specified set of control points is allowed. The use of poison eigenvectors for the reactor geometry and materials allows the poison to interact with the materials and geometry through the flux. The specification of control points allows the eigenvectors to reflect the control positions. It is shown that any critical flux that can be achieved with arbitrary poison at the control points can be represented as a sum of the control eigenfunctions. The least mean square optimum power is found using Gauss non-linear search techniques with the poison eigenvectors supplying the connection between power and poison. Conventional techniques show excellent agreement between fluxes and between powers for a given poison distribution. The power approaches flatness as the number of control points (or regions) approaches the number of power samples. 12 references. (auth)

7238 (CONF-730414-P2, pp VIII.1-VIII.19) OVERVIEW OF CURRENT TRENDS IN APPLICATIONS OF PROCESS CONTROL COMPUTERS TO NUCLEAR POWER PLANTS. Lunde, J. E. (Institutt for Atomenergi, Halden, Norway). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A review is given of the current trends in the development of automated systems for control and supervision of nuclear power stations, with the main attention on the increasing role of process computers. Modular systems now being developed are discussed. The functional role of a process computer system in a nuclear plant is discussed, and the use of quantitative methods that can be used for evaluation of alternative computer structures, is suggested. The advantages to be gained by introducing computerized protection systems are outlined. Several operational and economical advantages can be gained by the introduction of a computer-based control room with extensive utilization of color display units and operator's consoles. Problems that exist in relation to an appropriate organization of the information that should be presented to the plant operator are discussed. The incentives for applying direct digital plant control are outlined, and the particular features of modern control methods in relation to nuclear power plant control are indicated. The introduction of core power distribution control systems holds considerable potential for improved operations management and fuel cycle performance. A method, based on the modern control approach and already experimentally tested, is described. 32 references. (auth)

7239 (CONF-730414-P2, pp VIII.36-VIII.57) REVIEW OF ON-LINE COMPUTER APPLICATIONS IN NUCLEAR POWER STATIONS IN EUROPE. Hoermann, H. A. (Technische Univ., Munich). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A scope of the various supervision and control functions which are commonly carried out by process computer systems installed in European nuclear power plants is presented. This is done with regard to the different requirements of the used reactor types and power levels. Special emphasis is put on advanced methods, which are permitted by the computer use and provide an improved plant performance. The hard- and software characteristics of the computer systems are described and experiences are reported concerning the operational reliability. 28 references. (auth)

7240 (CONF-730414-P2, pp VIII.65-VIII.82) OPERATIONAL CONTROL OF SPATIAL XENON OSCILLATIONS IN LARGE POWER REACTORS. Poncelet, C. G.; El-Bassioni, A.; Impink, A. J. Jr. (Carnegie-Mellon Univ., Pittsburgh). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The spatial xenon control problem is considered from an operational point of view. The objective is to eliminate on-going oscillations in minimal time, with minimal control actions, under design, operational, and fuel integrity constraints, and with due consideration of operator response time and human error potential. A formal approach to practical control procedures is formulated with the aid of the Pontryagin Minimum Principle directly in terms of axial offsets, and the physical concepts underlying the procedures

are clarified. Examples are given of control simulations using a digital computer on time-share mode with a remote terminal, that links the reactor core, control system and instrumentation to a human operator in continuous operation in a linear transformation of real time. Suggestions are made for the use of on-line process control computers for the implementation of the control procedures. Recent experimental verifications of the control procedures in operating large PWR plants are discussed. 9 references. (auth)

7241 (CONF-730414-P2, pp VIII.83-VIII.90) CONTROL ROD INSERTION DURING EARTHQUAKE. Gluekler, E. L. (General Electric Co., Sunnyvale, CA); Batenburg, A. 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A hybrid computer model has been set up to study control rod insertion under seismic excitation. The purpose of the study was to ascertain how much, if any, the insertion would be delayed by seismic forces. A description of the analytical model and preliminary results are given. (auth)

7242 (ORNL-TM-2034(Rev.)) REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). Volume V. Instrumentation and Controls. Cagle, C. D.; Bates, A. E. G.; Carpenter, G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 295p. Dep. NTIS $16.75.

A basic reactor operator training manual on reactor instrumentation and controls is presented. The programmed instruction technique is used for the presentation of the material. Chapters are included on principles of electricity, radiation detection, reactor operation system, control instrumentation, instrument behavior during an orderly reactor startup, and process instrumentation. (JWR)

7243 (STI/PUB-341) NUCLEAR POWER PLANT CONTROL AND INSTRUMENTATION 1973. Proceedings Series. Proceedings of a Symposium Held in Prague, Czechoslovakia, January 22-26, 1973. (International Atomic Energy Agency, Vienna (Austria)). Jul 1973. 895p. (In several languages). (CONF-730108-). IAEA $34.00.

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

An assessment of the latest experience in the design, operation, and maintenance of control and instrumentation systems is provided. Abstracts have been prepared for each of the fifty nine papers. (FS)

For abstracts of individual papers see: 5041, 5186-5191, 6843, 6868-6870, 6908, 6916, 6917, 6988, 7105-7117, 7195-7197, and 7244-7271.

7244 REVIEW OF RESEARCH AND DEVELOPMENT WORK ON CONTROL ELEMENTS FOR NUCLEAR POWER STATIONS: THE MEDIUM-TERM PROSPECTS. Furet, J. (CEN de Saclay, Gif-sur Yvette, France). pp 3-28 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Current developments in nuclear power station engineering throughout the world are summarized. The course of this development in recent years is analysed with reference to economics, station size (scale effects) and operational results. The role of control and instrumentation in present and future development is examined in terms of economics (investment, price per kWh), availability, load factor (in particular, potential output and constraints imposed by the grid), operating safety, and the control and utilization of fuel. The future of control and instrumentation is then analysed from the point of view of research and development in areas where partial conclusions may be drawn and where problems still exist. The following points are discussed: (a) kinetics and dynamics of the reactor core: the acquisition of neutron and thermal data (reactivity coefficients); research undertaken and methods likely to be used for spatial control; the importance of methods of calculation and simulation; (b) the possible application of modern control theories for determining how nuclear power stations should be equipped and operated (the disproportion between the volume of research undertaken and practical applications is emphasized); (c) the effect of using digital computers in monitoring and control systems: experimental results are presented to illustrate the advantages and disadvantages of using computers; the merits of new systems are briefly considered with reference to their use in safety systems; (d) the importance of measuring instruments for monitoring and control, and the diagnosis of operating faults: the technological problems to be solved are enumerated and the status of research on sensors is reviewed; and (e) the reliability and ease of maintenance of monitoring and control equipment, and the effect of these factors on plant availability: new developments in reliability analysis are reported and the factors which at present make it difficult to acquire useful experimental data (i.e., operational data) are particularly emphasized; test programs on every kind of component and the acquisition and analysis of operating experience are shown to be important factors in establishing reliability. After reviewing the importance of human factors, control and instrumentation influences are analyzed. The influence of the inevitable compromise between safety, availability, and economics in nuclear power stations is discussed. (auth)

7245 NOTES ON THE AGENCY'S ACTIVITIES IN THE CONTROL AND INSTRUMENTATION OF NUCLEAR REACTORS. Keddar, A. (International Atomic Energy Agency, Vienna). pp 29-54 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In addition to the technical assistance of the Agency to the developing countries in the field of reactor control and instrumentation through fellowships, projects and research contracts, the Agency recently (March 1971) established a program for the control and instrumentation of nuclear power plants. Some problems encountered and some results obtained since the establishment of the Working Group on Nuclear Power Plant Control and Instrumentation (NPPCI) are presented. Some comments and suggestions are added when necessary. (auth)

7246 OPERATING EXPERIENCE WITH THE INSTRUMENTATION OF THE STADE NUCLEAR POWER STATION. von Haebler, D. (Siemens AG, Erlangen, Ger.). pp 57-70 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The Stade instrumentation is a further development on that installed at the Obrigheim nuclear power station. It contains many improvements regarding long life availability of measuring systems, better supervision of core parameters and an extended reactor protection system. The slider elements, which now incorporate the ex-reactor neutron flux detectors and make detector replacement possible at full load, have proved themselves completely. Regarding in-core instrumentation, the new Aeroball measurement system for the discontinuous measurement of the exact neutron flux or power distribution has performed excellently. The dynamic reactor protection system taken over from Obrigheim again proved completely reliable. In future plants, the active safety functions dealing, for example, with primary coolant leaks will be initiated by the dynamic system, and not by a standard static system, as used in Strade. Better matching of safety limits to actual plant limits will in the future lead to the use of protection criteria based on more extensive plant measurements. The process computer has been implemented for the first time in Stade as a dual unit. This approach will not be pursued further since, in the meantime, a larger computer has become available. The program package READAT, which provides a standard solution for both the nuclear programs and the operating logs, has operated entirely satisfactorily, and will be used without modification in subsequent plants. (auth)

7247 OPERATING EXPERIENCE WITH CONTROL AND INSTRUMENTATION SYSTEMS IN CEGB NUCLEAR POWER PLANTS. Jervis, M. W. (Central Electricity Generating Board, Cheltenham, Eng.); Dixon, F. pp 71-87 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

A large proportion of the world's electricity generation from nuclear reactors has been produced in United Kingdom plants and all these are fitted with control and instrumentation systems which include automatic data processing or computer systems. This has allowed considerable experience to be accumulated of many aspects of the operation of such systems, including difficulties and reliability actually obtained in service over some years. The systems in service in CEGB "Magnox" reactor power stations and of some systems now being tested for CEGB and UKAEA power plants not yet in service are described. Operating experience with the control and instrumentation systems at

the working stations is discussed and comments made on the design and performance and desirable extensions, particular reference being made to the use of new techniques such as computers and cathode-ray tube display systems. Availability figures over extended periods of operation of computers in service and the types of failure are reported. The results of tests at works and site are discussed for the other nuclear power station computer systems, with reference to methods of defining acceptance criteria and some difficulties which have occurred with these systems. An approach to quantifying the cost penalties associated with non-availability of control and instrumentation is described. Experience at Wylfa Nuclear Power Station has demonstrated that computer systems can be satisfactorily specified and that they can be successfully installed and operated. (auth)

7248 OPERATING EXPERIENCE WITH THE MONITORING AND CONTROL SYSTEM AND WITH THE INSTRUMENTATION OF THE MONTS d'ARREE NUCLEAR POWER STATION (EL4). Decool, F.; Godefroy, G.; Lourme, P. (Centrale Nucleaire des Monts d'Arree, La Feuillee, France). pp 89-110 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The EL4 monitoring and control system is characterized by a high degree of automation which, at the same time, affords operators the possibility of intervening in the functioning of the equipment at different levels. Technical and financial appraisals are presented of the three components of this system: centralized data processing designed for surveillance and management, electronic analog control circuits and cabled logic circuits in the form of static relays. The results are highly satisfactory and confirm the value of this type of automation for power-station operation. The instrumentation, which consists of three systems: the flux measurement system, based on 120 neutron-electron converters (in commercial operation); the conventional neutron measurement circuits; and the quick-response gas-temperature gages at the outlets of certain channels are presented. The EL4 instrumentation and in particular the monitoring and control system can be regarded as successful. (auth)

7249 LEVEL OF AUTOMATION AND USE OF COMPUTERS AT THE FRENCH NUCLEAR POWER STATIONS CURRENTLY IN OPERATION. Langlade, R.; Leroy, R. (Electricite de France, Paris). pp 123-150 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The advantages and disadvantages of three representative systems are compared by considering the following nuclear power plants: The Chooz station, which has a conventional system very like that of fossil-fuelled plants; Unit 2 at Chinon, where a centralized computer system does most of the information processing and performs a limited number of control functions; Unit 2 at Saint Laurent, where a central computer with stand-by performs almost all the control and information processing functions. Some data on the costs of running each system are given going on to consider for each system the corresponding aggregate of automatic information processing equipment and other facilities available to the operating staff. Experience has shown that the introduction of centralized computer systems does not fulfil all the hopes of the operators. Maintenance and the replacement of defective components and obsolete assemblies therefore present serious problems. Various solutions are considered but uncertainties remain concerning the nature of these solutions and the costs involved. (auth)

7250 LESSONS FROM DUNGENESS B AND OTHER POWER STATION COMPUTERS. Lowe, B. (FERRANTI Ltd., Manchester, Eng.). pp 151-158 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The on-line digital computer system for Dungeness "B" Nuclear Power Station was specified in 1964-65. The computers monitor virtually all the instrumentation signals from the reactors, pressure vessels, turbines and general plants to provide alarm, display, and logging facilities. The computer has direct digital control of reactor functions, boiler operation, and turbine run-up. The computer system was delivered in 1970 and is now in use for plant commissioning. Problems have occurred with operational requirements which have led to the initial design outline being considerably revised. Several examples are given to illustrate the type of problems encountered and the corresponding solutions, which were sometimes unexpectedly expensive. The system has recently reached saturation in one or two critical timing areas. The application of direct control demands a high level of system integrity. The principles used are outlined with some comments on the basic assumptions are made. The fault detection and rectification philosophy is described and its limitations discussed. An improved system configuration has been used on later stations, including Hartlepools and Heysham "A". Reliability has been a major concern throughout the project. Recorded availability figures are given for site operation to date, and these show clearly the argument which is leading to the complete replacement of the analog signal scanning system. Initial reliability and performance of this system was satisfactory but it is proving too costly and difficult to maintain. Maintenance aspects of the software are discussed with examples of actual fault types discovered, and the problems inherent in their detection and correction. The importance of correct operational tape-handling procedures is underlined. The difficulties encountered on this project are compared with similar computer applications. Normal problems are aggravated by the importance of integrity and availability in power station operation. This has led to a re-appraisal of simple dedicated computers for selected small isolated tasks and to the use of different processor, store and input-output configurations to enable easier programming of efficient standby control. Current trends in the marketing of on-line processors help to make different approaches more economically attractive for the future. (auth)

7251 DETECTION OF LEAKS IN THE PRIMARY CIRCUIT OF STEAM GENERATORS AT NUCLEAR POWER STATIONS WITH WATER COOLED AND MODERATED REACTORS. Antonov, V. L.; Zhernov, V. S.; Kiselev, B. L.; Matveev, V. V.; Ryzhov, N. V.; Skatkin, V. M. (State Committee for the Utilization of Atomic Energy, Moscow). pp 159-167 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The early detection of leaks in the primary circuit and rapid, planned action to normalize the situation and protect operating personnel increase the probability of reliable nuclear power plant operation, ensure operational safety and exclude the risk of environmental contamination. Methods whereby various radioisotopes present in the primary coolant are used as radioactive tracers have become widespread. A leak detection method based on measurements of the hard beta radiation from nitrogen-16 in the steam of the secondary circuit and the design principles and operating parameters of the equipment in its application to nuclear power stations with water moderated and cooled reactors are described. The hard beta radiation from nitrogen-16 is measured directly in the steam pipes of the secondary circuit by Geiger counters built to withstand high temperatures. Reliable monitoring of each steam generator is achieved also by using scintillation detector units to maintain a check on the total activity of the drainage water; this is supplemented by overall monitoring of the gases from the steam generator group as they leave the ejector, the gas component of the activity being measured by means of detector units with a capacity of 20 litres. The information from the detector units is fed into data processing equipment in the station control room. Each monitoring point is provided with an independent functional analogue count rate meter. The necessary sensitivity for early leak detection is provided by a multichannel reversible scaler. The entire measuring circuit is monitored continuously by an automatic fault-detecting system. There is also provision for remote calibration of the majority of the detector units. The instruments, detector units and control panels are assembled from standard modules consisting of microelectronic elements. (auth)

7252 ACQUIRED KNOWLEDGE AT THE START UP OF THE RAPSODIE FORTISSIMO FAST REACTOR ON POWER MEASUREMENTS AND THEIR CONTROL: ADAPTATION TO THE PHENIX POWER STATION START UP. Gourdon, J. (CEN, Cadarache, France). pp 175-186 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Thermal and neutronic methods used at the startup of the Rapsodie-Fortissimo fast reactor in order to determine powers and control them are described. Results obtained on thermal balances,

subassemblies power and core centre linear power are compared. The various methods are discussed in view of their utilization for the startup of the Phenix power station. (auth)

7253 APPLICATION OF PICKERING EXPERIENCE TO FUTURE CANADIAN NUCLEAR POWER STATIONS. Yaremy, E. M.; Anderson, D. E. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). pp 187-212 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The 2000-MW Pickering Nuclear Generating Station has been producing electrical power since April, 1971. Three of the four generating units are now producing full power (1500 MW total) with the output capacity factor of each unit approaching that of a fully mature station. The overall plant control scheme including system design aspects as well as particular hardware aspects of the instrumentation used is reviewed. The operating reliabilities of both the systems and hardware are discussed as well as the lessons learned for application on future stations such as the 3000-MW Bruce station now under construction. The application of the dual direct digital computer control system for all the complex plant control systems, including reactor control, has been a success. The dual computer arrangement is being carried over into future stations although certain changes are being made in the design development and commissioning stages of the project. The ease of making substantial program changes while producing full electrical output has been proven and the acceptance of the new control tool by the operating staff has been complete. However, experience has shown that improvements can be made in the communication link between the computer and the operator. The Pickering regulating system uses resistance temperature detectors and in-core neutron flux detectors as the main reactor power measurement signals and uses light water chambers in the reactor as the main reactor bulk and spatial control elements. Some difficulties have been experienced with the system components as well as with the spatial control concept itself. This has forced fairly substantial system changes, all carried out at full power through the computer system. The reactor protective system has functioned well with the few superious reactor scrams traceable to two main sources: electrical noise pickup on the neutron overpower scram signals, and failure of the electrical power scheme to give adequately reliable power. The results of the Pickering experiences are being applied at this time to the designs of future Candu nuclear power stations. (auth)

7254 REQUIREMENTS FOR LARGE NUCLEAR POWER PLANTS FROM THE STANDPOINT OF THE USER. Heining, U. (Rheinisch Westfaelisches Elektrizitaetswerk AG, Essen). pp 213-218 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In recent years nuclear demonstration plants have been erected. The utilities, which bought these power stations, operated them cautiously with regard to new techniques. Today quite a number of ordered power plants are nuclear stations, and they have to meet the requirements of the utilities. Requirements the RWE demands for modern light-water reactor power plants in relation to the load-following operation, availability and reliability of operation and emergency systems, state of the control system and control room, automatic control and the use of computer systems are explained. (auth)

7255 ASSESSMENT OF THE USE OF REACTIVITY METERS IN NUCLEAR POWER PLANTS. Gariod, R. (CEN, Grenoble, France); Tournier, E.; Vuong Quan Mai; Plaige, Y. pp 219-228 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Since 1966 the CMR-66 and CMR-67 reactivity meters are in use with most of Europe's nuclear reactors. Information recently obtained from users of these reactivity meters now makes it possible to assess their performance and the value of the service they perform. Progress was made with electronic dividers, especially as regards their stability and the possibility of linking them to different PAGELS networks, and as a result it seems likely that more specific reactivity meters will soon be available, in particular meters capable of handling a wide dynamic range. Source reactivity meters, where the main difficulty is to obtain a representative flux measurement, are also being studied. Reference is made to safety reactivity meters operating at rated power. Finally, consideration is given to possible new uses such as controlled power reduction or the surveillance of power reactors while shut down. (auth)

7256 MONITORING, CONTROL AND INSTRUMENTATION OF THE PHENIX NUCLEAR POWER STATION. Chapelot, A. B.; Jeannot, A.; Prouteau, L. (CEN, Saclay, France). pp 231-254 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The salient features of the systems for monitoring and control and the instrumentation of the Phenix nuclear power station are described, which consists of a sodium-cooled fast neutron reactor and a power plant producing 250 MW(e). The design of the power plant control system is discussed. Because of the numerous measurements, actuators and all-or-none data involved, digital computers must be used to handle the data. The theory underlying the use of this equipment has led the monitoring and control design team (1) to adapt special computers for surveillance and detection of fuel element plugging, with a view to ensuring reactor safety (the arrangements for calculation processing and the various sensor and computer redundancies are explained) and (2) to develop new procedures and means of verbal communication between the operator and the station data processing computers, and to lay down specific operational sequences (the new utilization of cathode screens for defect signalling together with the station status charts facilitate the dialogue between operator and machine). The smooth operation of a sodium-cooled fast reactor core requires numerous redundant monitoring operations to provide adequate data for the safety systems. The monitoring devices are in part conventional, similar to those found in other reactors (neutron monitoring, monitoring of fuel-element temperatures), and in part new and experimental (acoustic monitoring of core noise, new burst slug detection and localization equipment, reactivity-linked safety devices). Equipment in the latter category has already undergone an experimental phase and a preliminary operational phase in the Rapsodie fast reactor and in out-of-pile sodium testing rigs. On the basis of experience gained in building reactors, all the methods used at the manufacturing plant and on site to test the various systems for the monitoring and control of the power station are described. Particular attention is paid to methods of testing and calibrating sodium instrumentation, and also to tests conducted at the manufacturing plant on simplified models for automated equipment. There is a description of the initial test results obtained on site with the monitoring and control systems, and their initial try-out during power station tests. (auth)

7257 NUCLEAR POWER STATION CONTROL DEVELOPMENT. Butterfield, M. H. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 255-264 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

A wide range of topics essential to the choice, design and development of the load following controls on SGHWR and their implementation on the prototype reactor at Winfrith in Dorset, England is discussed. The grid supply network requirements are discussed first together with their influence on control system design. In combination with other plant conditions the basis for the choice of a load-following system is then described. The system design procedures involving simulation, its construction, installation and testing are described and some performance results quoted. To make efficient use of the control system design procedures it is necessary that the plant model be as accurate as possible for this purpose. Methods of achieving this, developed at Winfrith, are described. (auth)

7258 DEVELOPMENT OF A CONTROLLER WITH HIGH AVAILABILITY FOR A NUCLEAR POWER REACTOR. Giordano, P.; Novelli, P.; Pulacci, A. (CNEN, Rome). pp 265-274 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The CIRENE concept for nuclear power plants is based on vertical pressure-tube reactors, moderated by cold heavy water, cooled by boiling light water and fuelled with natural uranium dioxide. On account of the neutron absorbing effect of the cooling light water, the reactor shows a positive power to reactivity co-

efficient, and is intrinsically unstable. As a result the reactor operation requires a continuously operating control system whose availability is a major concern of the plant and also has a deep impact on the plant safety. Therefore, in the frame of the Research and Development program for the CIRENE reactors, a particular effort was made to develop all the components concerned for the reactor control. The main features of the neutron power control system of the CIRENE Prototype reactor (now under construction at Latina), based on a special controller built for high availability are described. After describing the main conceptual characteristics of the reactor control, the particular features of the controller are outlined, through which the required performances are obtained. (auth)

7259 PROCESS COMPUTER SYSTEMS WITH HIGH RELIABILITY AND ADVANCED OPERATOR COMMUNICATION EQUIPMENT FOR NUCLEAR POWER PLANT APPLICATION. Lunde, J. E.; Netland, K.; Palmgren, T.; Ovreeide, M. (OECD Halden Reactor Project, Norway). pp 275-288 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In view of the strong trend towards using extensive process computer applications for the monitoring, control and protection of nuclear power plants, a significant need for computer systems with better reliability/cost characteristics and better operator/process communication features than those commonly available at present has been envisaged. Two advanced prototype computer systems, a decentralized modular process computer system (DEMP) and an operator-communication system (OPCOM) have been developed at the OECD Halden Reactor Project and are being prepared for experimental operation of the Halden Reactor. The technical and economic features of these computer systems in light of current developments in computer technology as well as the demands to improved control systems emerging from more advanced nuclear power plant design are discussed. The problems associated with the appropriate structuring of user functions on modular systems and for computer-based communication systems are also discussed. (auth)

7260 SIMULATION STUDIES OF THE OPTIMAL DIRECT DIGITAL CONTROL OF THE A-1 REACTOR. Karpeta, C.; Stirsky, P.; Volf, K.; Roubal, S. (Power Research Inst., Praque). pp 289-302 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Computer-aided simulation of the digital control of the Czechoslovak nuclear power plant A-1 reactor approximating the nominal steady state is presented. Modern control theory approach has been adopted and the problem of the optimal control of the reactor is formulated as a discrete-time linear-quadratic-Gaussian (LQG) problem. Following the lines of the separation theorem, the effects of choosing different performance index weighing matrices are studied primarily for deterministic optimal control with all state variables accessible for measurement. Some properties of the Kalman filter for the process state estimation are then investigated. The results of the analysis of the more realistic stochastic control are given. (auth)

7261 DEVELOPMENT AND APPLICATION OF ADVANCED CONCEPTS FOR NUCLEAR PLANT AND CORE CONTROL. Grumbach, R.; Blomsnes, B. (OECD Halden Reactor Project, Norway). pp 303-317 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Concepts for closed-loop computer control of both the plant power production and the core power distribution have been developed and tested at the OECD Halden Reactor Project. The plant control concept was based on the optimal control theory for linear systems subject to quadratic performance criteria. This approach was taken because the theory as well as the control system design procedure is simple and well established, and because it results in a simple control algorithm. However, an important addition to a straightforward application of the theory was introduced to reduce the sensitivity of the control system to differences between the (non-linear) reactor process and the linear model, from which the control algorithm was derived. This addition consisted in an augmentation of the state description with a number of artificial variables which represented the discrepancy between the linear model and the true process. This measure resulted in a control system which is applicable over a wide power range (load-follow) without adjustment of controller settings. The described plant and core control concepts have been studied in simulations or applied in experiments at the Halden Boiling Water Reactor. A sample of representative results is presented. It is concluded that the chosen approaches are promising for the control of large nuclear power plants, and the applications to such plants are studied. (auth)

7262 APPLICATION OF MODERN CONTROL THEORY IN NUCLEAR POWER. Cummins, J. D.; Butterfield, M. H. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 319-335 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The following topics are reviewed: modern control theory concepts used in plant identification; control system design; investigations of spatial xenon phenomena, boiling water reactor noise and stability; fuel management; and in load changing situations. Where analytical techniques have been applied the results obtained have not always been completely satisfactory owing to difficulties mainly concerned with non-linearities of various types and the large number of differential equations generally required to define nuclear power systems. A specific case to optimize a nuclear reactor transient response following a demanded load change is considered. The possibility of future applications and some of the immediate difficulties which need to be overcome are discussed. (auth)

7263 QUALITY ASSURANCE POLICY ADOPTED BY THE CEGB FOR NUCLEAR CONTROL AND INSTRUMENTATION. Ellis, B. G.; Malins, B. H. (Central Electricity Generating Board Headquarters, London). pp 451-460 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The performance of a nuclear power station is dependent upon the control and instrumentation equipment operating correctly and reliably. The CEGB policy is to encourage and direct manufacturers to develop management techniques for the control of quality. The manufacturer's overall quality control methods should extend into every part of his organization which will include design, purchasing, manufacture, test and inspection, dispatch, site installation and commissioning. Involvement in purchasing must ensure that supplies and services from subcontractors conform to the specification requirements. Tools, process plant and working conditions must be suitable to meet a defined quality. An effective inspection and test procedure, throughout the manufacturing process, is necessary for the maintenance of quality standards. The methods of packing for protection during storage and dispatch should be clearly defined to ensure the safety and condition of equipment. Experience gained from site commissioning and subsequent service is used to develop the quality assurance procedures that are applied. (auth)

7264 REACTOR SURVEILLANCE BY STRESS-WAVE DETECTION AND ACOUSTIC DETECTION. Gasc, B.; Tomachevsky, E. G. (CEN, Saclay, France). pp 479-494 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In any nuclear power station it is important to receive the earliest possible warning of an emergent defect and to follow its evolution so as to be able to take the necessary action in good time. For this reason there is a need for a variety of reactor surveillance systems. Among non-destructive monitoring techniques, methods based on stress-wave detection and acoustic detection are sure to be further elaborated in the near future. Both these methods are described; the results obtained, and the difficulties encountered and the improvements envisaged are described. The first method allows the integrity of a structure and the second method the proper operation of a system to be checked. The investment required is minimal. (auth)

7265 ALGORITHM FOR THE COMPUTATION OF THE RELIABILITY OF COMPLEX SYSTEMS REGARDING DEPENDENT FAILURES. Kuklik, B.; Semerad, V.; Khylek, Z. (Power Research Inst., Prague). pp 495-502 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The algorithm for the computation of reliability of complex systems and devices with dependent failures is presented. The special algorithm which enables one to work with algebraic expressions is discussed. Its principle consists of attaching of two convenient vectors to any individual algebraic expression and of assigning such operation with these vectors so that logical rules applicable to dependent failures may be respected. Regarding to the logical scheme it is necessary to work with algebraic expressions as for as the level where the dependencies still occur. Then the calculation passes from the alternative with dependent failures to the alternative free of them and only the real values of reliability characteristics of the object elements are treated. To illustrate the possibilities of the method the calculation of reliability of the representative control circuit is presented. (auth)

7266 USE OF A COMPUTER TO IMPROVE THE SAFETY OF A FAST REACTOR CORE. Audoux, M. S. (EURATOM, Karlsruhe, Ger.). pp 529-544 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

One of the main concerns about the safety of a fast reactor is the necessity of identifying local incidents to prevent an evolution which may lead to serious core damage or even to a major accident. The detection of disturbances in the cooling channels of a sodium-cooled fast-breeder requires the use of an in-core instrumentation and the processing of the outcoming signals. The number of these signals is especially large and the detection of the disturbance requires a discrimination between temperature thresholds and operating temperatures which are just a few degrees apart. The operating conditions of the sensing elements are so severe that a substantial percentage of detector failures has to be taken into account. The use of customary logical circuits does not permit one to distinguish the deterministic character which would lead to the identification of a cooling disturbance from stochastic events like the decalibration of a thermocouple. These considerations have led to the proposal of another solution where a first step sorts the apparently disturbed subassemblies by using a special grouping technique. The sorting operation involves a specific combination of the signals which is not based on the classical use of logical functions but on a more flexible method where different numerical weighting factors can be applied to include the safety criteria, the redundancy of the instrumentation, the credibility of the signal and the background of the detectors. The sorting process can be so fast that most of the cycle time is left to carry out some detailed investigations on a minority of suspicious cases. These detailed investigations are divided according to their priority and use algorithms which are applied not on single values but on sequences of points. The process can formulate better diagnostics by verifying the steadiness of the signals, by classifying the critical profiles, and by checking the coincidence of such profiles. Application of the method to a fast breeder shows that a reduction of the false scram signals could be achieved by using such a method. This approach differs some what from the classical applications of computers to the nuclear safety. One has not tried to adapt a computer to a safety scheme but rather an attempt has been made to analyze the safety problems which could be efficiently solved with the help of a computer. (auth)

7267 DEVELOPMENT OF THE NOISE THERMOMETER AND ITS TESTS AS AN IN-CORE TEMPERATURE DETECTOR. Brixy, H.; Hecker, R.; Overhoff, T. (Kernforschungsanlage, Juelich, Ger.). pp 637-648 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In contrast to thermometers that have been used up to now (thermocouples, resistance thermometers etc.), the noise thermometer is independent of all environmental influences such as reactor radiation or atmosphere. It is independent of its previous thermal and mechanical treatment and of the material used. Consequently, the noise thermometer retains its initial precision even after any length of application time. This property is important for the application in nuclear reactors requiring long periods of exposure. Noise thermometry is based on the Nyquist theorem of thermal noise. Noise temperature measurements were carried out in fuel-element positions in the FRJ2, and it was experimentally proved that even an intense reactor radiation does not influence the function of the noise thermometer. A series of measurements was carried out in the range of 300 and 500°K, where all the noise temperatures were within the range of a calibration accuracy of 0.5% of the reference thermocouples. At the end of the experiment (duration: three reactor periods), the noise thermometer was exposed to an integral thermal neutron flux of 3×10^{20} n/cm^2, and the noise resistor had changed by 6%. The operating capacity of the noise thermometer had, of course, not been impaired in any way by this process. The experiment also showed that the noise thermometer is applicable when the distances between thermometer and amplifier are great (in this case 18 m) and in an environment with intense electromagnetic interference fields. Noise thermometry can therefore be used as a measuring method under rough conditions in nuclear reactors. (auth)

7268 TEMPERATURE MONITORING IN NUCLEAR POWER PLANTS (TIHANGE). Montmayeru, R. (Etablissements Merlin et Gerin, Grenoble, France). pp 659-672 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

In a nuclear power plant the only way to check the measurements required for the proper operation of a facility would be to use multi-directional graph recorders. But owing to the large number of parameters that have to be monitored, this procedure soon proves to be costly and impracticable. At the TIHANGE Power Plant, three MGS 240 scanners are used for monitoring 720 temperatures. As soon as one of the temperatures exceeds the threshold or goes beyond its sensitivity zone, the equipment warns the operator by an acoustic alarm, and identifies the faulty channel by lighting an individual blinker of an instrumentation panel. The operator can then follow the abnormal temperature by connecting the corresponding channel to a graph recorder designed for such a purpose. (auth)

7269 CORRECT MEASUREMENT OF NEUTRON FIELD PARAMETERS IN NUCLEAR REACTORS. Garapov, E. F.; Inikhov, A. G.; Lomakin, S. S.; Panfilov, G. G.; Petrov, V. I.; Samoilov, P. S. (State Scientific Research Inst. of Instrumentation, Moscow). pp 691-698 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Measurement of the spatial flux density distribution and of the spectral parameters of the neutron field in the core can provide useful data for assessing the efficiency and reliability of power reactors-for example, data on the energy release distribution, fuel burnup during a reactor run, the radiation resistance of construction elements, etc. Very full and accurate data may be obtained by using a comprehensive range of activation detectors, including thermal neutron detectors (gold, cobalt, lutetium, europium, copper, dysprosium), resonance detectors (indium, gold, samarium, tungsten, lanthanum, cobalt, manganese, copper, sodium) and threshold detectors (rhodium, indium, nickel, zinc, iron-56, iron-54, aluminium, copper). For measurements at ambient temperatures of up to 500°C, the authors use thin-from the point of view of neutron absorption-thermal and resonance neutron detectors in the form of alloys containing aluminium (apart from NaF detectors), while for temperatures up to 1000°C they employ minute detectors distributed through a matrix of silicon or aluminium oxide (indium and zinc threshold detectors). The flux density measurement range is from 10^7 to $5 \cdot 10^{14}$ n/cm$^2 \cdot$ sec. Measurements of induced activity are performed with a scintillation or semiconductor gamma spectrometer, which is calibrated against calibrated gamma sources (for example, those supplied by the IAEA). By way of example, the results of measurements of the neutron field parameter distribution in the power reactors at Novovoronezh, Obninsk and in the VK reactor are presented. The principal sources of measurement error are analyzed. However, a drawback of the activation method is the lack of continuity in the supply of information. Continuous monitoring of neutron field parameters is achieved with direct charge detectors, ionization chambers and wire-machine monitors. The correctness of measurements made with these detectors depends on the accuracy of calibration with due allowance for the effect of different neutron energy groups and perturbation of the neutron field by the detectors themselves. Calibration accuracy is increased by calibrating under conditions similar to those encountered during reactor operation-for example, directly in the channels of power reactors, a set of activation detectors being used for calibrating the neutron field in the channels. In addition, neutron detectors used in reactor monitoring systems are calibrated in the F-1 graphite reactor

using a neutron source (thermal neutron flux 10^5 –10^{10} n/cm^2 · sec) which has been calibrated by a metrology organization. Thus, the correct measurement of neutron field parameters in power reactors is based on the use of the activation method for the periodic monitoring of parameters and the calibration of the detectors employed in the continuous monitoring systems. (auth)

7270 MINICOMPUTERS FOR NEUTRON MEASUREMENTS IN NUCLEAR REACTORS. Jover, P. (CEN, Saclay, France). pp 733-742 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

Digital computers have been used widely in the operation of nuclear reactors. In most cases, such computers are used for processing measurement data and indications of emergency situations, the display of message and the analysis of reactor incidents. In some cases, the computer participates more or less directly in the control of the plant, the aim being to achieve better performance. However, the different parameters characterizing the operation of the core (for example, nuclear power, period and reactivity) are still measured by means of analogue equipment. With the recent advent of cheap and highly reliable minicomputers it was felt that the time had come to build experimental equipment – using standard components in association with such a minicomputer – capable of controlling the nuclear power of a reactor. Different parts of the experimental equipment which has been built at the Centre d'Etudes Nucléaires de Saclay and tested on a low-power reactor are described. An account is also given of the experience gained over several months of operation. (auth)

7271 SELECTION OF DETECTORS FOR FAILED FUEL ELEMENT DETECTION BY MEANS OF DELAYED NEUTRON MEASUREMENT. Melichar, Z. (Power Research Inst., Prague); Moravec, Ya.; Loupushinski, Ya.; Rintsarzh, Ya.; Yanikouski, A. pp 843-848 of Nuclear Power Plant Control and Instrumentation 1973. Vienna; International Atomic Energy Agency (1973). (In Russian).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973). See STI/PUB-341; CONF-730108-.

The selection of detectors for failed fuel element detection by means of delayed neutron measurement. Experimental and computational works for the comparison of several types of detectors for failed fuel element detection by means of delayed neutron measurement, are described. The comparison included helium, BF_3 and corona counters and fission chambers. A source–detector geometry optimization was performed for water and polyethylene moderators. Neutron sources Am-Be and Am-Li in different gamma fluxes were used for calibration. (auth)

7272 (T-743, pp 2.104-2.110) COMPUTER AIDED CONTROL OF THE NUCLEAR REACTOR TRIGA MARK II. Divjak, S.; Krajnik, J.; Tasic, J. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From second European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

In TRIGA Owners' Conference.

The description of the additional instrumentation and software required to couple the nuclear reactor Mark TRIGA-2 with the digital processor CDC 1700 and an auxiliary teleprinter is presented. The system must allow the automatic logging of several most important parameters of the reactor and easy interaction between the operator and the system. (auth)

7273 OPTIMAL CONTROL ROD POLICIES FOR AN OPERATING CYCLE OF A SIMULATED BOILING WATER REACTOR CORE. Snyder, M. B.; Lewis, E. E. (Northwestern Univ., Evanston, IL). Trans. Amer. Nucl. Soc.; 17: 228(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7274 IMPROVED RESPONSE OF BWR POWER PLANTS TO RAPID LOAD CHANGES. Josefsson, R.; Karlsson, R.; Blomberg, P. E. (AB Atomenergi, Nykoeping, Sweden). Trans. Amer. Nucl. Soc.; 17: 435(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7275 PLATINUM SELF-POWERED DETECTOR RESPONSE IN A SIMULATED BOOSTED CANDU LATTICE. French, P. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Kroon, J. C.; Shields, R. B. Trans. Amer. Nucl. Soc.; 17: 448-449(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7276 USING A SELF-POWERED PLATINUM FLUX DETECTOR FOR IN-CORE MEASUREMENTS IN A BWR. Seifritz, W.; Gebureck, P. (Technische Univ., Hanover). Trans. Amer. Nucl. Soc.; 17: 449-450(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7277 SLOWPOKE: A DEMONSTRATION OF SIMPLIFIED REACTOR CONTROL AND UNATTENDED OPERATION. Kay, R. E.; Hilborn, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 17: 453(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7278 COMPARISON OF CALCULATED AND MEASURED CONTROL ROD WORTHS IN ZPPR ASSEMBLY 3. Stewart, S. L.; Hartman, A. K. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 17: 455-456(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7279 AXIAL POWER AND PHOTON HEATING SHIFTS DUE TO PARTIAL CONTROL ROD INSERTIONS IN ZPPR ASSEMBLY 3. Maddison, D. W.; Simons, G. G.; Gasidlo, J. M. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 17: 460-461(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7280 HEATING RATES AND WORTHS OF CONTROL ASSEMBLIES IN AN LMFBR. Gibson, G.; Dyos, M. W. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 17: 473(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7281 COMPARISON OF TRANSPORT APPROXIMATIONS FOR REACTOR PHYSICS CALCULATIONS IN A FAST REACTOR. Flanagan, G. F. (Oak Ridge National Lab., TN); Greene, N. M.; Engle, W. W. Jr.; Tomlinson, E. T. Trans. Amer. Nucl. Soc.; 17: 486-488(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7282 BWR CRITICAL DETERMINATIONS. Parkos, G. R.; Foreman, C. E.; Brammer, H. A. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 17: 502(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Nuclear Power Plant Economics

7283 (CONF-730414-P2, pp VL38-VL57) STOCHASTIC PRODUCTION COSTING WITH NUCLEAR UNIT GENERATION AND REFUELING CONSTRAINTS. Goodrich, J. M.; Rees, F. J.; Wells, H. G. (Systems Control, Inc., Palo Alto, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Nuclear reactors require careful planning of systems operations over a multi-year period due to the batch reloading nature of nuclear fuel and the length of the nuclear fuel cycle. Electric utilities must develop acceptable operating strategies which schedule nuclear refuelings, plant maintenance, and expected unit generation so that the system load is satisfied reliably at low cost. A production costing program, PROCOS, is described which employs probabilistic techniques to obtain accurate predictions of unit loadings in a computationally efficient manner. 4 references. (auth)

7284 NUCLEAR POWER GROWTH PAINS PERSIST. Olds, F. C. Power Eng.; 77: No. 11, 55-61(Nov 1973).

Charts and tables are shown that demonstrate the slippage dates for nuclear power plant completions in the United States. The industry must commission an average of 11 plants per year through 1978, and 21 per year for the next four years if schedules are to be met to supply the necessary power needed. The shortfall in the output from nuclear power plants has to be compensated for. The nation can cut back, economize, import more oil, gas and kilowatts, or develop alternate sources of energy. On September 5, 1973, President Nixon stated that possible Arab threats to use oil to force changes in the U. S. international policy would make the U. S. develop other sources of energy. The usual, familiar sources that have been discussed over and over are there, but are too far into the future to be of much immediate help. Two options that are less often mentioned are the relaxation of the pollution abatement laws and regulations and the second alternate is the tapping of gas reserves in Siberia to feed the U. S. market. Siberian gas flows into Europe now. Japan is reported dickering for a share of Siberian gas through the proposed U. S. pipeline. (MCW)

Reactor Fuel Cycle Economics

7285 (CONF-730414-P1, pp II.1-II.28) METHODS OF FUEL MANAGEMENT ANALYSIS: AN OVERVIEW. Crowther, R. L. (General Electric Co., San Jose, CA). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Fuel management analysis involves all of the major problems of reactor physics coupled with multistage decisions that include the important technological, safety, and economic constraints on reactor design and operation. The methods used in fuel management analysis are reviewed with emphasis on reactor physics mathematical methods and problems. Several techniques for direct solution to obtain optimal fuel and absorber management are reviewed. 46 references. (auth)

7286 (CONF-730414-P1, pp II.29-II.42) AN ALGORITHM FOR DETERMINING OPTIMUM FUEL MANAGEMENT DECISIONS WITH GENERALIZED CYCLE REQUIREMENTS. Forkner, S. L.; Specker, S. R. (Tennessee Valley Authority, Chattanooga, TN). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

A method of simulating optimal fuel management decisions for cycles of varying length and energy output is described. It was developed for the purpose of providing the power system planner with the minimum fuel cycle cost achievable when operating a nuclear unit in accordance with a particular refueling outage and energy production schedule. A pattern search method is used to generate a sequence of decision alternatives leading to the optimal alternative. Optimal incore fuel placement is simulated in one dimension by formulating the internal fuel management problem as the assignment problem of linear programming. Core neutronics is treated in one dimension. Several applications are presented. 14 references. (auth)

7287 (CONF-730414-P1, pp II.43-II.55) APPLICATIONS OF NONLINEAR PROGRAMMING TECHNIQUES IN MULTISTAGE FUEL MANAGEMENT OPTIMIZATION. Rothrock, R. B. (Univ. of Washington, Seattle); Garlid, K. L.; Omberg, R. P. 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Mathematical models and computational techniques for analysis of nuclear systems.

The single plant multistage refueling optimization problem with fixed energy production requirements at each stage is treated as a nonlinear program, with replacement batch size and enrichment for each cycle to be chosen for minimum total cost. Feasible multistage refueling policies are constrained at each stage by limits on end-of-cycle reactivity, peak specific power, and maximum allowable burnup or in-core fuel residence time. Differential nonlinear programming techniques are employed to obtain stage-dependent cost sensitivities for the active constraints, which can be used to guide the search procedure in an optimum-seeking computer code, and to study the structure and consequences of interstage coupling induced by the partial-batch nature of the refueling process. Examples are presented of the use of stage-dependent constraint cost sensitivities to study the behavior of minimum-cost refueling policies for various types of highly constrained nonequilibrium multistage refueling problems. 13 references. (auth)

7288 (CONF-730414-P2, pp VI.58-VI.83) METHODS FOR CALCULATING INCREMENTAL FUEL COSTS FOR NUCLEAR ENERGY. Watt, H. Y.; Benedict, M.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

The problem of optimal dispatching of electricity from nuclear power plants can be formulated as follows: given certain nuclear plants in a utility system, what is the optimal way of scheduling energy production among them such that the system's demand for nuclear energy is satisfied and the total fuel cycle cost is minimized? Investigation of this problem is part of a mid-range system planning model under development at MIT. 7 references. (auth)

7289 (CONF-730414-P2, pp VI.84-VI.139) METHODS FOR NUCLEAR IN-CORE OPTIMIZATION. Watt, H. Y.; Kearney, J. P.; Benedict, M.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). 1973.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems, Ann Arbor, Michigan, USA (8 Apr 1973).

In mathematical models and computational techniques for analysis of nuclear systems.

Utility system planning, over the mid-range five to ten years, requires a very rapid sub-optimization of all of the nuclear plants in the system. This sub-optimization, repeated several times, must optimize the nuclear fuel reloading strategy for each nuclear plant that will produce a set of cycle energies, E_i, during cycles having durations, T_i, over the planning horizon. The objective function whose value is minimized in this work is the revenue requirement associated with the fuel cycle costs of a nuclear power plant throughout the planning horizon of interest. The revenue requirement is that sum of money, which if received as revenue by an investor-owned electric utility at the beginning of the planning horizon and invested in the enterprise, will defray all subsequent fuel cycle costs, the return allowed by regulatory agencies on that portion of the original investment remaining unexpended at any time, and defray all associated income taxes. 6 references. (auth)

Reactor Licensing and Regulation

Refer also to abstract 4960.

7290 (DOCKET-50003-218) INDIAN POINT STATION, UNITS 1 AND 2. Monthly Report on Fish Collections, August 1973. (Consolidated Edison Co. of New York, Inc., New York (USA)). 4 Sep 1973. 5p. (DOCKET-50247-149). Dep. NTIS $3.00.

7291 (DOCKET-50219-337) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure to Set to Average Power Range Monitor Scram and Rod Block Set Points to the Conservative Values as Specified. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 16 Oct 1973. 3p. Dep. NTIS $3.00.

7292 (DOCKET-50237-417) DRESDEN NUCLEAR POWER STATION, UNIT 2. Malfunction of Shutdown Cooling Valve MO-2-1001-2B. (Commonwealth Edison Co., Chicago, Ill. (USA)). 5 Nov 1973. 2p. Dep. NTIS $3.00.

7293 (DOCKET-50250-180) TURKEY POINT PLANT, UNITS 3 AND 4. Notification of Utility Workers Strike. (Florida Power and Light Co. (USA)). 2 Nov 1973. 3p. (DOCKET-50251-165). Dep. NTIS $3.00.

7294 (DOCKET-50254-291) QUAD-CITIES STATION, UNITS 1 AND 2. Results of Temperature Surveys, February–August 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1973. 10p. (DOCKET-50265-277). Dep. NTIS $3.00.

Results of seven temperature surveys to verify predictions of the model tests concerning the diffuser pipe system and to evaluate diffuser pipe performance are presented. An inverse temperature stratification was observed downstream of the pipe with the highest temperature being at the bottom during winter surveys. During summer surveys, vertical temperature variations appeared to be greater upstream indicating relatively complete mixing with the lowest temperature at the bottom. Temperatures 500 ft downstream were rarely more than 1.2°C greater than ambient river temperatures. (FS)

7295 (DOCKET-50259-188) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO7320W: Events Involving Control Rods 54-27 ns 26-55. (Tennessee Valley Authority, Chattanooga (USA)). 12 Oct 1973. 2p. Dep. NTIS $3.00.

During replacement of a scram outlet valve seat on control rod drive 54-27, control rod 26-55 failed to insert with normal control rod drive pressure. Control rod 54-27 was valved in an inserted and control rod 26-55 was also inserted after raising the drive pressure. The reason for the occurrence is being studied. (JWR)

7296 (DOCKET-50259-220) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report Nos. BF EAO-7344W-7348W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 9 Nov 1973. 2p. Dep. NTIS $3.00.

7297 (DOCKET-50259-226) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Draft Environmental Statement, Supplements and Additions, Volume 3. (Tennessee Valley Authority, Chattanooga (USA)). 7 Sep 1972. 232p. (DOCKET-50260-129; DOCKET-50296-117). Dep. NTIS $18.75.

7298 (DOCKET-50263-255) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Sodium Pentaborate Solution Was Found in the No. 12 Standby Liquid Control Pump Lubricating Oil. (Northern States Power Co., Minneapolis, Minn. (USA)). 25 Sep 1973. 1p. Dep. NTIS $3.00.

7299 (DOCKET-50263-260) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Cycle 2 Scram Reactivity Considerations, Analysis and Modifications. (Northern States Power Co., Minneapolis, Minn. (USA)). 10 Oct 1973. 34p. Dep. NTIS $3.75.

7300 (DOCKET-50263-271) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Incident Report: The Average Planar LHGR and the Local LHGR Were Not Checked in Accordance with Surveillance Requirements. (Northern States Power Co., Minneapolis, Minn. (USA)). 13 Nov 1973. 1p. Dep. NTIS $3.00.

7301 (DOCKET-50269-168) OCONEE NUCLEAR STATION, UNIT 1. Startup Report. (Duke Power Co., Charlotte, N. C. (USA)). 16 Nov 1973. 171p. Dep. NTIS $10.75.

Reactor start-up information concerning the initial fuel loading, testing prior to initial criticality, and performance of the core, cooling systems, auxiliary systems, and the steam and power conversion systems is presented. Nuclear design parameters are confirmed and the Oconee class reactor is verified for operation in accordance with design criteria at power levels up to and including full rated power. (FS)

7302 (DOCKET-50275-65) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Apparent Discrepancies in the Manner in Which Work Was Performed on the Nuclear Steam Supply System Primary Loop Piping. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 25 Oct 1973. 5p. Dep. NTIS $3.00.

7303 (DOCKET-50277-133) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report: Switches PS-2-5-120 and PS-2-2-3-550 Were Found to Operate Slightly Beyond Specification Limits. (Philadelphia Electric Co., Pa. (USA)). 19 Sep 1973. 3p. Dep. NTIS $3.00.

7304 (DOCKET-50277-134) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Temperature Switch TS-2-12-99 Was Found to Be Out of Calibration. (Philadelphia Electric Co., Pa. (USA)). 1 Oct 1973. 3p. Dep. NTIS $3.00.

7305 (DOCKET-50277-140) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrences: Internal Inspection of the RHR System Valve MO-154-B Disclosed Defective Tack Welds Between the Valve Disc and Stem Nut. High Pressure Service Water System Disclosed Pump Capacities Below Technical Specifications. (Philadelphia Electric Co., Pa. (USA)). 15 Oct 1973. 3p. Dep. NTIS $3.00.

7306 (DOCKET-50277-156) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Four Oxygen Analyzer System Isolation Valves Were Found to be Inoperable. (Philadelphia Electric Co., Pa. (USA)). 9 Nov 1973. 2p. Dep. NTIS $3.00.

7307 (DOCKET-50280-190) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-12: Loss of Control Room Emergency Bottled Air Supply. (Virginia Electric and Power Co., Richmond (USA)). 31 Oct 1973. 7p. Dep. NTIS $3.00.

7308 (DOCKET-50282-171) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report of Loose Impeller on Containment Spray Pump. (Northern States Power Co., Minneapolis, Minn. (USA)). 24 Oct 1973. 3p. (DOCKET-50306-137). Dep. NTIS $3.00.

7309 (DOCKET-50282-172) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Deficient Radiography of Four Residual Heat Removal Pump Castings. (Northern States Power Co., Minneapolis, Minn. (USA)). 17 Oct 1973. 4p. (DOCKET-50306-138). Dep. NTIS $3.00.

7310 (DOCKET-50282-173) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Restraint of Safety Injection System and Residual Heat Removal Piping During Hot Functional Testing. (Northern States Power Co., Minneapolis, Minn. (USA)). 2 Oct 1973. 3p. (DOCKET-50306-139). Dep. NTIS $3.00.

7311 (DOCKET-50282-174) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Ventilation Fan Motors. (Northern States Power Co., Minneapolis, Minn. (USA)). 24 Oct 1973. 4p. (DOCKET-50306-140). Dep. NTIS $3.00.

7312 (DOCKET-50282-175) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Interim Report on Collapse of No. 121 Chemical and Volume Control Holdup Tank. (Northern States Power Co., Minneapolis, Minn. (USA)). 10 Oct 1973. 3p. (DOCKET-50306-141). Dep. NTIS $3.00.

7313 (DOCKET-50285-135) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-4: Repair of Component Cooling Water Pump. (Omaha Public Power District, Nebr. (USA)). 23 Oct 1973. 4p. Dep. NTIS $3.00.

7314 (DOCKET-50285-140) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-5: Failure of D-1 Diesel to Start on Secondary Air Starting System. (Omaha Public Power District, Nebr. (USA)). 13 Nov 1973. 4p. Dep. NTIS $3.00.

7315 (DOCKET-50289-136) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Suppression Diode Failure in a 480 Volt Breaker. (Metropolitan Edison Co., Reading, Pa. (USA)). 1 Nov 1973. 4p. Dep. NTIS $3.00.

7316 (DOCKET-50293-201) PILGRIM NUCLEAR POWER STATION, UNIT 1. Technical Justification for Continued Operation at 50% Power and 50% Flow. (Boston Edison Co., Mass. (USA)). 14 Nov 1973. 22p. Dep. NTIS $3.25.

The effects of worn-through fuel channels on the plant thermal hydraulics, reduction of recirculation flow on channel wear, interference on control rod drive operation, abnormal operation transients, loss of coolant and steam line break accidents were analyzed. The conservatism of operation at 50% design power and 50% recirculation flow is demonstrated. (FS)

7317 (DOCKET-50295-197) ZION NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation of Weld Channel Pressurization System. (Commonwealth Edison Co., Chicago, Ill. (USA)). 14 Nov 1973. 2p. (DOCKET-50304-131). Dep. NTIS $3.00.

7318 (DOCKET-50298-98) COOPER NUCLEAR STATION. New Method for Initial Fuel Loading. (Nebraska Public Power District, Columbus (USA)). 24 Oct 1973. 8p. Dep. NTIS $3.00.

7319 (DOCKET-50309-141) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. AO-73-4: Discrepancy in the Application of Flux Peaking Augmentation Factors. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 8 Oct 1973. 3p. Dep. NTIS $3.00.

7320 (DOCKET-50309-151) MAINE YANKEE ATOMIC POWER PLANT. Fish Impingement Studies. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 30 Oct 1973. 4p. Dep. NTIS $3.00.

7321 (DOCKET-50309-154) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. 73-6: Analysis of a Sample from the RWST Showed the Boron Concentration to be Lower than Required by the Technical Specification. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 31 Oct 1973. 1p. Dep. NTIS $3.00.

7322 (DOCKET-50352-62) LIMERICK GENERATING STATION, UNITS 1 AND 2. Final Environmental Statement. (Phila-

delphia Electric Co., Pa. (USA)). Nov 1973. 692p. (DOCKET-50353-62). Dep. NTIS $36.75.

The environmental effects of construction and operation of the Limerick Generating Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

7323 (DOCKET-50369-43) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. RO Inquiry Report No. 73-1Q and Correspondence re Major Fire at Vendor's Facility. (Duke Power Co., Charlotte, N. C. (USA)). 4 Oct 1973. 6p. (DOCKET-50370-43). Dep. NTIS $3.00.

7324 (DOCKET-50416-57) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. License Application. (Mississippi Power and Light Co., Jackson (USA)). 22 Sep 1972. 34p. (DOCKET-50417-57). Dep. NTIS $3.75.

7325 (DOCKET-50416-58) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. License Application, Environmental Report. (Mississippi Power and Light Co., Jackson (USA)). 1972. 590p. (DOCKET-50417-58). Dep. NTIS $31.50.

The environmental effects of construction and operation of the Grand Gulf Nuclear Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

7326 (DOCKET-50463-1) FULTON GENERATING STATION, UNITS 1 AND 2. License Application. (Philadelphia Electric Co., Pa. (USA)). 16 Nov 1973. 50p. (DOCKET-50464-1). Dep. NTIS $4.50.

7327 (DOCKET-50463-3) FULTON GENERATING STATION, UNITS 1 AND 2. Environmental Report, Volume 1. (Philadelphia Electric Co., Pa. (USA)). 1973. 710p. (DOCKET-50464-3). Dep. NTIS $37.50.

The environmental effects of construction and operation of the Fulton Generating Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

7328 (DOCKET-50463-4) FULTON GENERATING STATION, UNITS 1 AND 2. Environmental Report, Volume 2. (Philadelphia Electric Co., Pa. (USA)). 1973. 698p. (DOCKET-50464-4). Dep. NTIS $37.00.

Appendices are presented concerning the PJM method of loss-of-load probability calculations used to determine generation reserve requirements and reliability; population data based on pre-census projections; archeological report; ecological observations of the Ferncliff wildlife and wild flower preserve; source terms; policy and program for improving appearance of transmission lines; time dose calculational model for evaluating impact of gaseous effluents; ecological monitoring; ecological observations of alternative sites; alternative sites water quality data; alternative sites geology; radioactive source term calculation data; temperature distributions in Conowingo Pond; and water quality standards and requirements. (FS)

7329 (DOCKET-50463-5) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 1. (Philadelphia Electric Co., Pa. (USA)). 1973. 558p. (DOCKET-50464-5). Dep. NTIS $30.00.

The HTGR type reactors have a proposed thermal power level of 3000 MW(t) with a net electrical output of ~1160 MW(e) for each unit. Safety analysis and site evaluation are based on 3164 MW(t) and 1220 MW(e). June 1980 is the scheduled completion date for Unit 1 and Unit 2 is scheduled for completion in June 1982. The reactor site is in Lancaster County, Pennsylvania on a high terrace overlooking Conowingo Pond, opposite the Peach Bottom Atomic Power Station. There will be two natural draft hyperbolic cooling towers. Site characteristics including geography, demography, meteorology, hydrology, geology, and seismology are described. Design criteria concerning wind; tornado; flooding; missile protection; seismic design of Category I structures, instrumentation, and electrical equipment; mechanical systems and components; and environmental design of mechanical and electrical systems are presented. (FS)

7330 (DOCKET-50463-6) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 2. (Philadelphia Electric Co., Pa. (USA)). 1973. 530p. (DOCKET-50464-6). Dep. NTIS $28.50.

The reactor is a high temperature gas-cooled reactor employing a $^{235}U/Th$ fuel cycle, helium cooling, and graphite moderator. Fuel materials are 93.15% enriched U in the carbide form and fertile thorium in the oxide form. Initially ^{235}U comprises the total fissile loading with design provisions to later use recycled ^{233}U as a feed material. The uranium carbide particles are coated with pyrolytic carbon and silicon carbide with thorium oxide particles coated with pyrolytic carbon. The core, reactor vessel internals, and reactivity control systems are described in detail. Helium is used as the primary coolant to transfer heat from the reactor core to the steam generators to produce steam for power generation. Information concerning the integrity of the reactor coolant pressure boundary, thermal and fluid flow, reactor vessel and appurtenances, component and subsystem design, and instrumentation is presented. Engineered safety features mitigate the consequences of accidents having low probability of occurrence. The containment and the core auxiliary cooling, which ensure a safe cooldown of the core and continued shutdown, habitability systems, and PCRV penetration flow restrictors, are described. (FS)

7331 (DOCKET-50463-7) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 3. (Philadelphia Electric Co., Pa. (USA)). 1973. 478p. (DOCKET-50464-7). Dep. NTIS $26.00.

Information is presented on the instrument and control systems provided to ensure that the unit is safely operated, and in the event of an accident can be safely shutdown and maintained in a safe shutdown condition without endangering public health and safety. Information is presented concerning the trip system, engineered safety features systems, systems required for safe shutdown, safety related display systems, other systems required for safety, control systems, and reserve shutdown systems. (FS)

7332 (DOCKET-50463-8) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 4. (Philadelphia Electric Co., Pa. (USA)). 1973. 515p. (DOCKET-50464-8). Dep. NTIS $27.75.

Offsite and onsite power systems; fuel storage and handling; water systems; process auxiliaries; heating, ventilation, and air conditioning systems, and other auxiliary systems are described. Information is presented concerning management of solid, gaseous, and liquid wastes. The process and effluent radiation monitoring systems and the offsite regional radiological monitoring program are discussed. The steam and power conversion system which is described, produces electric power from the main steam and hot reheat steam supplied by the steam generators; supplies cold reheat steam to the helium circulators and reheaters; condenses steam and returns it to high quality, heated feedwater for the steam generators; and provides steam to the auxiliary steam system. (FS)

7333 (DOCKET-50463-9) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 5. (Philadelphia Electric Co., Pa. (USA)). 1973. 477p. (DOCKET-50464-9). Dep. NTIS $26.00.

Information is presented concerning shielding; ventilation; the health physics program; organizational structure of the applicant; training; emergency plans; review and audit; plant records; maintenance; testing; events leading to radioactivity, fission product, or tritium release to the environment; and quality assurance during design and construction. Technical specifications including safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, and administrative controls are discussed. (FS)

7334 (DOCKET-50463-10) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 6. (Philadelphia Electric Co., Pa. (USA)). 1973. 435p. (DOCKET-50464-10). Dep. NTIS $23.75.

The following appendices are presented: responses to safety guides, geology at the Fulton site, engineering seismology of the site, surface and ground water hydrology, boring logs, seismic study, hypothetical fission product release, PCRV development,

research and development programs relating to plant design, supplementary reactor materials and chemistry data, and symbols used in the PSAR. (FS)

7335 COMPLIANCE WITH NUCLEAR REGULATORY REQUIREMENTS BY THE CENTRAL ELECTRICITY GENERATING BOARD. Haire, T. P. (Central Electricity Generating Board, London). pp 507-520 of Principles and Standards of Reactor Safety. Vienna; International Atomic Energy Agency (1973).

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973). See STI/PUB-342; CONF-730217-.

Licensing of sites for the construction and operation of nuclear power stations in the United Kingdom is provided for by the Nuclear Installations Act 1965. Under the authority given by this Act the Secretary of State for Trade and Industry is empowered to grant a license to a corporate body for the construction, commissioning and operation of a nuclear power station and by conditions attached to the License to control in the interests of safety the building and operation of nuclear reactors, and similar installations. These conditions form a major part of the system of regulatory control. They have evolved over the years and now cover each nuclear project from the very early manufacturing and construction stages through commissioning to the operational phase. The Nuclear Installations Act also imposes an absolute liability on the licensee for injury to persons and damage to property resulting from the radioactive, toxic, explosive or other hazardous properties of nuclear matter. Further regulatory control governing the discharge and disposal of radioactive waste, and the keeping and use of radioactive materials, is provided by the Radioactive Substances Act 1960. This Act protects the public against ionizing radiations from radioactive waste. Before nuclear waste is disposed of it is necessary to obtain an authorization from the relevant Government Departments. The Central Electricity Generating Board, which is responsible for providing bulk supplies of electricity to all parts of England and Wales, is the largest single operator of nuclear power stations in the world having at present 16 gas cooled magnox fuelled operating reactors and 8 advanced gas cooled reactors under construction. From the early stages of its nuclear program the Board has been subject to the requirements of the relevant nuclear legislation, and in particular the Nuclear Installations Act and the Radioactive Substances Act. The basic requirements of the relevant legislation are defined. How the Generating Board ensures that it fully complies with these requirements is described. (auth)

7336 TECHNIQUES FOR EFFECTIVE INTERFACING: OWNER, ENGINEER, VENDOR. Bjeldanes, M. N. (Northern States Power Co., Minneapolis); Vellender, G. C.; Claeson, E. U. Trans. Amer. Nucl. Soc.; 17: 389-390(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7337 INTRODUCTORY REMARKS. Hellman, S. K. (Ralph M. Parsons Co., Los Angeles. Trans. Amer. Nucl. Soc.; 17: 430(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7338 N45.2.13: SUPPLEMENTARY QUALITY ASSURANCE REQUIREMENTS FOR CONTROL OF PROCUREMENT OF EQUIPMENT, MATERIALS AND SERVICES FOR NUCLEAR POWER PLANTS. Keeley, G. S. (Consumer Power Co., Jackson, MI). Trans. Amer. Nucl. Soc.; 17: 430-431(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7339 N45.2.8: QUALITY ASSURANCE REQUIREMENTS DURING INSTALLATION, INSPECTION, AND TESTING OF MECHANICAL EQUIPMENT AND PIPING FOR THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. Basile, G. (US Testing Co., Inc., Hoboken, NJ). Trans. Amer. Nucl. Soc.; 17: 432-433 (Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7340 N45.2.9: REQUIREMENTS FOR QUALITY ASSURANCE RECORDS FOR NUCLEAR POWER PLANTS. Bain, R. S. (Pacific Gas and Electric Co., San Francisco). Trans. Amer. Nucl. Soc.; 17: 433-434(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7341 N45.2.11: QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS. Bleiweis, A. (United Engineers and Constructors, Inc., Boston). Trans. Amer. Nucl. Soc.; 17: 434(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7342 SIMULATOR: KEY TO REQUALIFICATION. Connelly, J. (Carolina Power and Light Co., Raleigh, NC); Roman, W. Trans. Amer. Nucl. Soc.; 17: 435-436(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7343 FIDELITY CRITERIA DICTATE ESTABLISHMENT OF NUCLEAR SIMULATION STANDARDS. Hughes, T. E. C.; Cullingford, M. C.; Deaton, I. V. (Singer Co., Silver Spring, MD). Trans. Amer. Nucl. Soc.; 17: 436-437(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

GENERAL

Civilian Defense

7344 (ORNL-4900) TRANS-PACIFIC FALLOUT AND PROTECTIVE COUNTERMEASURES. Kearny, C. H. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $4.00.

Extrapolations were made from the measured results of lower tropospheric fallout deposited in the United States from four of the first five Chinese tests. It is estimated that if during a war in which the US is not a belligerent, 65 megatons of similar weapons were detonated on or over China so as to produce similar lower tropospheric debris, then in extensive areas of the 50 states much milk would be dangerously contaminated with radioactive iodine. The degree of ^{131}I concentration would exceed that of the lower limit of the Federal Radiation Council's Range III, the range of the highest level of ^{131}I contamination specified in FRC Report No. 2. Report No. 2 warns that a sharply rising trend in Range III would suggest strong and prompt action. Hazards and expected long-term casualties from eating other fallout-contaminated foods and from exposure to total whole-body γ doses of 1 to 10 rems from such trans-Pacific fallout in the year following a nuclear war are summarized. Also outlined are recommended protective countermeasures and the psychological-political advantages likely to be attained if the President and other high officials are prepared to give all Americans an early, factual account of the approaching trans-Pacific fallout dangers and of the protective countermeasures being taken to minimize casualties and economic losses. (auth)

Energy Utilization and Economics

Refer also to abstracts 6915, 7284, 7376, 7377, and 7394.

7345 (BNL-18213) INSULATING TAPE CHARACTERISTICS AT CRYOGENIC TEMPERATURES. Muller, A. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 11p. (CONF-731026-3). Dep. NTIS $3.00.

From conference on electrical insulation and dielectric phenomena; Varennes Quebec, Canada (29 Oct 1973).

Plastics selected for evaluation for insulation on the superconducting cable for power transmission were: addition polymers, polyolefins; addition polymers, fluorinated hydrocarbons; and condensation polymers. A demonstration model is under design for 69-kV system operation; the goal for the insulation is an operating stress of 250 V/mil. Literature values are given for dielectric loss for three temperatures at 60 Hz. In addition, the cost per 1000 feet of 1-inch wide by 0.005-inch thick tape is listed. The polyolefins are the least expensive, the fluorinated hydrocarbons are the most expensive, and the condensation polymers are intermediate in price. Polyethylene, polypropylene, and Teflon exhibit large plastic elongations and low elastic moduli. Polycarbonate, polysulfone, Nomex, Mylar, and other condensation polymers are materials that exhibit very high yield and tensile strengths. Nylon 6,6, Nylon 11, calendered Tyvek, and supercalendered Tyvek exhibit moderate values of the mechanical properties under investigation. (MCW)

7346 (HIT-500) STUDY OF THE FUTURE SUPPLY OF NATURAL GAS FOR ELECTRICAL UTILITIES. (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1972. 42p. (PB-209-285).

The availability of natural gas as a low sulfur fuel for electrical production was examined in light of historical usage and availability. The goal was to ascertain not only near term but extended demands. Projections were made out through the year 2000. Such alternates as coal and oil shale gasification, Liquid Natural Gas (LNG), and well stimulation were evaluated. The use of natural gas has been and will continue to be an important source of fuel within the United States. It represents a very clean fuel and, as a result, a fuel that can become an important control in the fight against pollution. Most industry spokesmen are forecasting a gas shortage during the 1972 through 1975 time period. The bulk of the solutions will not be available until the latter 1970s. These include such items as LNG import, synthetic gas production, and field stimulation. Gas power generation by electric utilities will decline on a percentage basis due to these shortages and will continue beyond the crisis due to high gas prices. The overall gas consumption, however, will continue to rise. This high consumption level will be met almost entirely by internal production until the latter 1970s. Imports from Canada and Mexico will yield only a small percentage of our demand. Beyond this, LNG imports will play an ever-increasing role. An attractive economic picture could yield LNG capturing 10 percent of the United States market by 1981 and increasing during the following years. Liquid natural gas will meet a large part of the United States demand, but cannot continue well into the 2000s. If gas is to continue its role, coal gasification must pick up the slack. This process can supply sufficient gas for at least another 100 years. This process is currently under pilot-plant investigation and could be developed to full-scale capabilities in the 1980's. (auth)

7347 (JUL-982-RG) APPROACH TO THE HOLISTIC ANALYSIS OF THE SYSTEM MAN–ENERGY–ENVIRONMENT. Voss, A. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Jul 1973. 193p. (In German). Dep. NTIS (U.S. Sales Only) $11.75.

Thesis.

Energy is generally considered as the main access to the modern industrial society. The availability of sufficient amounts of energy is due to fundamental importance for the development of society. Besides the demand on economical energy maintenance, there are intensively occurring ecological and supply–technical aspects, whose importance advances permanently with the exponential increase of the energy consumption. A holistic analysis for the system man–energy–environment regarding economical, ecological, and technical aspects is presented. The aim is to comprehend all significant influence factors and interactions as well as to compare and to evaluate the positive and negative effects of an increasing energy consumption and its protection by alternative energy supply systems. For such complex systems new methods developed in the field of system engineering, especially cybernetic simulation, have to be used for the derivation of adequate aid for decision. (auth)

7348 (LA-5301-MS) SILICA IN WATER IN RELATION TO COOLING TOWER OPERATION. Wohlberg, C.; Buchholz, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

Deposition of silica as a result of evaporative concentration in cooling towers is a problem in the Los Alamos, New Mexico, area. Factors bearing on this deposition, such as solubility, the nature of silica in solution, polymerization of soluble silica, stability of sols, and the specific nature of silica sols, as well as the factors involved in precipitation of silica from water are considered. The chemistry of clay formation with reference to insolubilization of silica is reviewed. Known methods of silica removal are critically examined. Alumina, iron oxides, and magnesia are commonly used. Ion exchange is not reviewed. A preliminary experimental program shows that an activated alumina used in a column effectively removes silica from the local water (from 80 ppm to almost zero ppm). Unanswered questions about silica deposition in water are pointed out. Methods of attack are suggested, and a program of investigation is proposed. (auth)

7349 (LBL-2102) COMPARISON OF ELEMENTARY GEOTHERMAL-BRINE POWER-PRODUCTION PROCESSES. Green, M. A.; Laird, A. D. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 2 Aug 1973. Contract W-7405-eng-48. 34p. (CONF-730846-1). Dep. NTIS $3.75.

From applied technology geothermal committee meeting; Idaho Falls, Idaho, USA (7 Aug 1973).

A comparison of three simple geothermal power-production systems shows that the flashed steam and the compound systems are favored for use with high-temperature brines. The binary system becomes economically competitive only when used on low-temperature brines (enthalpies less than 350 Btu/lb). Geothermal power appears to be economically attractive even when low-temperature brines are used. (auth)

7350 (ORNL-EIS-73-65) ENERGY RESEARCH AND DEVELOPMENT. A Selected Reading List. Guthrie, M. P., Huber, E. E.; Norwood, G. A. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 237p. Dep. NTIS $14.00.

A selected listing of 1,219 publications is assembled for the identification of promising areas for energy research and development. The document is designed to assist the layman. The genesis of the reading list was a need to gain a perspective on what has already been done in energy research and development. The perspective was required to support the development of a report to the President from the Chairman of the AEC on long-range energy research and development needs and policy as requested in the

President's June 29, 1973, statement on Energy and National Resources. The bibliography emphasizes general publications on energy sources, electric power, generation, energy uses, and references on energy supply and demand studies. An appendix includes an author index, a simple title index, and a permuted index on titles. (MCW)

7351 (ORNL-NSF-EP-50) PROJECTIONS OF ELECTRICITY DEMAND. Tyrrell, T. J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

With the arrival of the "Energy Crisis" the need for accurate predictions of electricity demand becomes crucial. For decades reasonably accurate results have been obtained by simple extrapolation of historical growth rates. Recently, however, changes have occurred in some of the underlying economic factors, increasing the desirability of a more sophisticated predictive approach. Recently developed econometric models describe electricity demand as a function of population, per capita income, and prices of electricity, gas, and electrical appliances. Some features of one such model illustrate the projections that can be made using it. These projections are found to be generally lower than other well-known forecasts, and, depending on assumptions, show a wide range of possible future electricity demand levels. (auth)

7352 (ORNL-NSF-EP-59) ROOM AIR CONDITIONER AS AN ENERGY CONSUMER. Moyers, J. C. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

As a part of the ORNL–NSF Environmental Program's effort toward conservation of energy, large differences in the efficiency with which room air conditioners consume electricity to provide cooling are pointed out and examined. Efficiencies range from 4.9 to 12.2 Btu/watt-hr. An improvement in average efficiency from 6 to 10 Btu/watt-hr is estimated to result in a total saving of 212 billion kW-hr during the 1973-80 period and a reduction in connected load to the electrical utilities in 1980 of almost 58,000 MW. A method for predicting the change in efficiency due to a change in design is developed and used to estimate the additional cost entailed in providing higher efficiency. A simple method for evaluating the monetary worth of the power saving at higher efficiency, from the individual's standpoint, is presented. (auth)

7353 (PB-207300) NUCLEAR ENERGY FOR A NEW TOWN. Hammerschlag, D.; Rose, V. C. (Rhode Island Univ., Kingston (USA)). Aug 1971. 76p. Dep. NTIS $6.00.

This document is concerned with methods of utilizing the waste heat from a proposed nuclear generating facility in an industrial–municipal complex. Several products and processes are proposed, including marine pharmaceuticals, chemical production, municipal waste processes, food production and processing, and residential–recreational uses. Sewage treatment was selected as the most promising use of the heat. This nonseasonal process can provide a solution to two regional problems: augmentation of municipal water supplies and elimination of a major source of water pollution. In the proposed system, sewage from the metropolitan Providence, R. I., area would be piped to the vicinity of the power plant, receive primary, secondary, and tertiary treatment to convert it to potable water and be piped back to the city's reservoir system. Heat from the power plant would be used in each stage to accelerate the process. Cost of the entire system was estimated at 74.3 million dollars. (auth)

7354 (SLA-73-919) INSTRUMENTATION SYSTEMS DEVELOPMENT FOR IN SITU PROCESSING. Northrop, D. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. Contract AT(29-1)-789. 43p. Dep. NTIS $4.25.

The need for new sources of energy has resulted in the development for in situ processing and process control instrumentation by Sandia Laboratories. Optimization of processing techniques for coal, oil shales, geothermal beds, magma taps, etc. require instrumentation for measuring and controlling the associated processes. The general aspects of the program at Sandia are discussed. Instrumentation, data processing, and modeling techniques are described. (MCW)

7355 COAL GASIFICATION FOR ELECTRIC POWER GENERATION. Lemezis, S.; Archer, D. H. (Westinghouse Electric Corp., Pittsburgh). Combustion; 45: No. 5, 6-12(Nov 1973).

The ultimate goal of the coal-gasification power system project is the demonstration on a commerical scale of an economic and environmentally acceptable electric generating plant that links a coal-gasification system with a combined-cycle plant adapted for burning low-Btu fuel gas. The development of a small-scale fluidized-bed gasifier is underway, and then the conceptual gasification process will be chosen for final scale-up to prototype size. The research program and its financing are discussed. The time schedules for progress made and the projections into 1981 are presented. (MCW)

7356 ROLE OF GAS AND STEAM TURBINES TO REDUCE INDUSTRIAL PLANT ENERGY COSTS. Wilson, W. B.; Hefner, W. J. (General Electric Co., Louisville, KY). Combustion; 45: No. 5, 32-41(Nov 1973).

Data are given to help industry select the economic fuel and economic mix of steam and gas turbines for energy-conservation measures and costs. Utilities and industrials can no longer rely on a firm supply of natural gas to fuel their boilers and turbines. The effect various liquid fuels have on gas turbine maintenance and availability is summarized. Process heat requirements per unit of power, process steam pressure, and the type of fuel will be factors in evaluating the proper mix of steam and gas turbines. The plant requirements for heat, and the availability of a reliable source of electric power will influence the amount of power (hp and kW) that can be economically generated by the industrial. (auth)

7357 TASKS AND PROSPECTS FOR THE TECHNICAL AND SCIENTIFIC PROGRESS IN THE THERMAL POWER ECONOMY OF THE SOVIET UNION. Neporoznii, P. S. (Ministry of Energetics and Electrification, Moscow). Arch. Energiewirt.; 27: No. 15, 709-716(1973). (In German).

The present state of development of power plant building in USSR is described. The following were examined: optimum block size and capacity depending on demand and type of fuel; comparison of costs of conventional and nuclear power plants; and the planning of fast breeder reactors. The technological efforts and intended measures (improvement of design solutions, conversion to normal construction parts, decrease of specific heat requirement, etc.) for the safety of the future energy supply are explained. (GE)

7358 AUSTRALIA SPEEDS UP SOLAR ENERGY RESEARCH. Scholes, W. A. Energy Int.; 10: No. 10, 17-18(Oct 1973).

Short-term projects are concentrated on improving the efficiency and reducing the cost of existing types of solar water heaters and solar water-desalination plants. Longer-term projects include fundamental studies on thermal transfer problems, energy measurement, heat storage media, and solar-energy collectors. An investigation of the distribution of solar energy over the continent is being carried out by CSIRO, Division of Atmospheric Physics. The development of devices for low-grade heat applications such as water heaters, air heaters, solar stills, and waste-heat solar stills is progressing. Transportation is a large consumer of primary energy in Australia, and extensive research and development is needed so that solar energy can provide both hydrocarbons and hydrogen as synthetic fuels to replace dwindling reserves of oil. Synthetic fuels could be produced from plants that used solar energy to fix atmospheric carbon. Solar cells could be used for the electrolysis of water to produce hydrogen as a fuel and solar-powered cars could be developed. (MCW)

7359 WASTE DISPOSAL: THE ALTERNATIVES OF COMBUSTION. Rochford, R. S.; Walker, J. D. Energy Int.; 10: No. 10, 15-16(Oct 1973).

Incineration of waste to produce a usable form of energy offers help toward the solution of the reduction of the quantity of municipal and industrial wastes and the conservation of fossil fuels. Waste can be burned as a supplementary fuel in combination with coal, oil, or gas in existing utility boilers. For suspension firing in combination with pulverized coal, oil, or gas, the waste should be prepared by two-stage shredding to a small particle size. Interstage pneumatic separation can remove the denser materials, primarily noncombustibles. These can be disposed of separately. Provision must be made to handle the ash and materials not consumed by combustion. For Cyclone Furnace firing the waste material is shredded to a particle size where it can be readily handled mechanically and pneumatically. The advantage here is that the noncombustibles need not be removed unless the economics indicate a benefit from recovering metal and glass. (MCW)

7360 DISTRICT HEATING CAN ANSWER REFUSE DISPOSAL PROBLEM. Energy Int.; 10: No. 10, 12-14(Oct 1973).

Incineration for the disposal of domestic and industrial wastes is coupled to district heating networks for the utilization of the energy generated. Problems for urban areas are the maintenance of a clean and tidy, healthy and enjoyable environment. The incineration of wastes combined with district heating facilities is discussed for several cities. Systems are advanced in Europe, and the systems in Nottingham and Coventry are discussed. The Japanese experience with waste disposal heat is explained. Stockholm's Hogdalen incinerator plant is one of two serving the city. The operation at the systems in Mannhein, Germany, France, and in North America is described. (MCW)

7361 NORTH DAKOTA LIGNITE BURNS CLEANLY IN CYCLONE FURNACE. Bougie, G. (Minnkota Power Cooperative,

Inc., Center, ND). Power Eng.; 77: No. 11, 62-65(Nov 1973).

High moisture North Dakota lignite was handled with ease during the first three years of operation. The furnace is a 235-Mw rated Babcock & Wilcox Cyclone located at Milton R. Young Generating Station of Minnkota Power Cooperative, Inc., at Center, N. D. Plant availability was 93.8% and output seldom fell below normal rating during most of the period since the start of commercial operation. No convection or furnace surface has been cleaned. Soot blower maintenance has been minimal. Cyclone risers are clean and slag tapping presents no problems. Performance on the lignite drying and air lift system continues to be satisfactory. (MCW)

7362 SUPERCONDUCTING HIGH POWER THREE-PHASE AC CABLES. Bogner, G. (Siemens AG, Erlangen, Ger.). Kerntechnik; 15: No. 8, 358-365(1973). (In German and English).

The makeup of a superconducting three-phase ac cable with coaxial conductor pairs is described. Thermal insulation can be ensured by means of techniques already used in the construction of containers for liquids with low boiling points. Suitable superconductor materials are niobium and niobium–tin. The most effective electric insulation is achieved with a multilayer tape winding of nonpolar plastics. The cable is cooled by two separate cycles operated with liquid nitrogen and liquid helium, both under a raised pressure. Distances of 10 km between cooling stations are possible. Comparisons with other novel high-power underground transmission systems indicate that the superconducting three-phase ac cable will probably be the most economic solution for the power ratings of about 2000 MW and over. (GE)

7363 SO_2 CONTROL: LOW-SULFUR COAL STILL THE BEST WAY. Engdahl, R. B.; Genco, J. M.; Jenkins, D. M.; Oxley, J. H.; Rosenberg, H. S. (Battelle Columbus Lab., OH). Power Eng.; 77: No. 11, 72-76(Nov 1973).

There are three immediate solutions for meeting the federal regulations requiring that low emission standards for SO_2 be met by all new power plants by 1975 and by existing power plants by 1977. Old plants can be abandoned, some favorably located plants can switch to low-sulfur fuel, and equipment can be developed to remove most of the SO_2 from the exhaust gases. Difficulties have existed in perfecting SO_2 cleanup systems. After a study of the acceptable and potential methods for cleanup of stack SO_2, it is still recommended that the only solution is for a switch to low-sulfur coal. (MCW)

7364 SWISS ENERGY POLICY FAVORS NUCLEAR POWER, NATURAL GAS. Dufrasne, R.; Swiss, M. Energy Int.; 10: No. 10, 27-28(Oct 1973).

In 1969, the authorities in Switzerland announced a policy to develop nuclear power and natural gas to reduce the nation's dependence on oil. This policy also furthers the aim of enhanced environment protection. Six nuclear projects, each with a capacity of 900 MW, are under construction and will meet the energy demands when completed. All hydroelectric sites have been developed that were feasible. Present nuclear capacity, 1000 MW, is in operation. Imports of natural gas are expected to increase. Conversion to natural gas in the Mitteland area was completed in 1972, in the GVS area is to be completed in 1974, and in the Gaznat area a start will be made in 1974. The pipeline system for transmission is discussed. (MCW)

7365 PRODUCTION OF METHANE-RICH FUEL GAS. Franz, W. F.; Hess, H. V. (to Texaco Inc.). US Patent 3,759,679. 18 Sep 1973. Filed date 23 Jul 1971. 8p.

A liquid hydrocarbon fuel is reacted with hydrogen and H_2O over a nickel oxide–chromium oxide catalyst at high pressure to produce a methane-rich fuel gas. Preferably, hydrogen in the product gas is recovered and totally recycled to the reaction zone. Optionally, CO_2 may be removed from the product gas producing substantially pure methane. (Official Gazette)

7366 INTEGRATED FLUID COKING/GASIFICATION PROCESS. Lahn, G. C. (to Esso Research and Engineering Co.). US Patent 3,759,676. 18 Sep 1973. Filed date 22 Jan 1971. 6p.

An invention is given for the conversion of a heavy carbonaceous material such as petroleum residuum to distillate and gaseous products by an integrated process consisting of coking the heavy carbonaceous material in a conventional fluid coking reactor, and gasifying the coke produced in an improved three-zone gasifying reactor. (Official Gazette)

7367 NUCLEAR VS COAL: AN ECONOMIC COMPARISON OF POWER PLANT ECONOMICS IN TEXAS. Macdonald, J. L.; Voltin, M. J. Jr.; Draper, E. L. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 17: 309-310(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7368 ECONOMIC MERIT ORDER RULES AND MARGINAL COSTS FOR DISPATCHING FOSSIL AND NUCLEAR UNITS. Prince, B. E.; Turnage, J. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 310(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7369 PROBABILISTIC SIMULATION AND OPTIMIZATION MODELS FOR NUCLEAR AND FOSSIL PLANT GENERATION PLANNING. Bennett, L. L.; Turnage, J. C.; Joy, D. S.; Prince, B. E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 311(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7370 STATUS OF WASTE HEAT UTILIZATION AND DUAL-PURPOSE PLANT PROJECTS. Beall, S. E.; Yarosh, M. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 17: 408(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Management

Refer also to abstract 7475.

7371 (MLM-2097) STABLE ISOTOPE SALES: MOUND LABORATORY CUSTOMER AND SHIPMENT SUMMARIES, FY-1973. Stringham, W. S. (comp.). (Mound Lab., Miamisburg, Ohio (USA)). 15 Nov 1973. Contract AT-33-1-GEN-53. 25p. Dep. NTIS $4.00.

A listing is given of Mound Laboratory's sales of stable isotopes of noble gases, carbon, oxygen, and nitrogen, for Fiscal Year 1973. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index by location is included for domestic customers. Cross-referenced listings by isotope purchased are included for all customers. (auth)

7372 (NP-19877) ANNUAL REPORT TO THE DIRECTOR-GENERAL OF HEALTH FOR THE YEAR ENDED JUNE 30, 1972. (Commonwealth Radiation Lab., Melbourne (Australia)). 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

Activities of the Commonwealth Radiation Laboratory (formerly x-ray and Radium Laboratory) during the year ending June 30, 1972, are discussed. These include maintenance of national standards for measurement of the activity of radionuclides and of exposure to x and γ radiation; maintenance of a personnel dosimetry service; the provision of advisory services on x-ray equipment; the loan of sealed sources of ^{226}Ra and ^{90}Sr and ^{222}Rn to hospitals; the procurement of all radiopharmaceuticals used in Australia for medical diagnosis and treatment; provide advice and assistance in the fields of radiation protection and equipment maintenance; and the provision of efficient technical library services. (CH)

7373 (NP-19880) DANISH ATOMIC ENERGY COMMISSION ANNUAL REPORT, 1 April 1972–31 March 1973. (Atomenergikommissionen, Copenhagen (Denmark)). Oct 1973. 149p. (In Danish). Dep. NTIS (U. S. Sales Only) $9.50.

Activities of the Danish Atomic Energy Commission and the Risø Research Establishment for the period April 1, 1972 to March 31, 1973 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, and a list of staff publications is given. (auth)

7374 (Y-DS-49) ECONOMIC MANUFACTURING QUANTITIES FOR A MULTIPRODUCT, SINGLE-FACILITY SYSTEM (NECESSARY AND SUFFICIENT CONDITIONS FOR SCHEDULE FEASIBILITY). Gray, J. R. (Oak Ridge Y-12 Plant, Tenn. (USA)). 18 Sep 1973. 15p. (CONF-731029-1). Dep. NTIS $3.00.

From Southeastern regional meeting, the institute of management science; Atlanta, Georgia, USA (18 Oct 1973).

The general theorem on schedule feasibility and its corollary removes a handicap suffered by other researchers who have studied the multiproduct EMQ inventory model described. These results also reveal the complex computational nature of a feasible schedule for $n \geq 2$ items that are produced on a single facility. (auth)

7375 NUCLEAR RESEARCH FACILITIES, JUELICH: STATE AND GOALS. Baden-Baden, Ger.; Wesel (1972). 116p. (In German).

An account of the activities of the KFA is discussed under the following topics: energy (pebble-bed reactor, HTR with helium turbine, refractories, thermionic diodes, MHD generator, fusion reactor); life and environment (nuclear methods in the fight against cancer, mutations, biological membranes, trace elements, heart investigations; meteorological problems of radioactivity, radioactive waste); and basic research (hot chemistry and kinetics, high-purity materials, large enrichment of nuclides, solid-state physics, nuclear structure). Finally, the organizational structure of the KFA and the winding up of research and development programs are reported. (GE)

7376 RESEARCH REPORT (IV) OF THE FEDERAL GOVERNMENT. Bonn; Heger (1972). 216p. (In German).

The full text gives information on the objectives and planning in research politics as well as a division of the main research projects. The advancement of nuclear energy is treated within the framework of energy gain on a national scale as well as the organizational measures to alter the structure of large research installations. The 3rd German Atomprogramme (1968–1972) reviews its main features in retrospect. The budget is included with detailed statistics. (GE)

7377 NUCLEAR ENGINEERING IN AN INTEGRATED PROGRAM FOR ENERGY AND POWER. Fazzolare, R. A. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 17: 55(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7378 DEVELOPMENT OF COURSE IN QUALITY ASSURANCE AS INTEGRAL PART OF NUCLEAR ENGINEERING CURRICULUM. Bohannon, J. R. Jr. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 17: 56-57(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7379 SUMMER WORKSHOP: AN EFFECTIVE APPROACH TO PUBLIC EDUCATION CONCERNING NUCLEAR ENERGY. Angelo, J. A. Jr.; Woodbridge, D. D. (Florida Inst. of Tech., Melbourne). Trans. Amer. Nucl. Soc.; 17: 58-59(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

7380 UNIVERSITY'S INVOLVEMENT IN MUNICIPAL DECISION MAKING ON NUCLEAR POWER. Voltin, M. J. Jr.; Macdonald, J. L.; Rombough, C. T.; Hansborough, L. D.; Barbee, S. G.; Vanston, J. H.; Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 17: 59-60(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Mathematics and Computers

Refer also to abstract 7411.

7381 (AWRE-O-30/73) DIFFAL: A COMPUTER PROGRAM FOR PREDICTION OF ATMOSPHERIC DISPERSION OF PARTICULATE DEBRIS. Robson, A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Sep 1973. 65p. Dep. NTIS (U. S. Sales Only) $5.25. UK £ 1.

This program, developed while AWRE was part of the UKAEA and titled DIFFAL, calculates ground level dosages and related parameters downwind of a large-volume, quasi-instantaneous, cloud of particulate debris. The shape and character of the debris cloud can be varied and the falling material can experience different atmospheric transport and dispersion conditions at different altitudes. The program has been written so that it can easily be expanded to consider situations other than the immediate objectives, namely: (1) to assess the hazard to man from inhalation of α-emitting debris following accidental, e.g., non-nuclear, detonation of a nuclear weapon; and (2) to assess the hazard from radioactive fallout debris deposited in the first few tens to hundreds of miles from ground zero following a land surface or underground nuclear, or thermonuclear, burst. (auth)

7382 (CEA-CONF-2430) THEORETICAL STUDY AND CONCEPTION OF AN AMBIGUITY MEASUREMENT IN REAL TIME. Garderet, P.; Kofman, W. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 16 Mar 1973. 20p. (In French). (CONF-730572-3). Dep. NTIS (U.S. Sales Only) $3.00.

From 4th colloquium on the processing of the signal and its applications; Nice, France (7 May 1973).

Calculation in real time of the ambiguity function of a signal is made possible by the method of addition of auxiliary signals and quantification of two levels. Simulation of this technique of calculation gave encouraging results, and apparatus operating on this principle is being developed at LETI. (tr-auth)

7383 (COO-1469-226) EVALUATION OF AN INTEGRATION TECHNIQUE FOR THE SOLUTION OF NONLINEAR EQUATIONS. Robb, J. H. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1973. Contract AT(11-1)-1469. 37p. (UIUCDCS-R-73-576). Dep. NTIS $4.00.

The method for solving systems of nonlinear algebraic equations that is the subject of this investigation was developed by van Melle. His subroutine DIFMF3 was designed to solve the steady-state problem of ordinary differential equations, and for this purpose each component of the vector to be solved for could be either a derivative or an ordinary variable. The development of this method grew out of ideas presented by Gear concerning the solution of systems of mixed algebraic and differential equations. (auth)

7384 (COO-3288-26) COMMENTS ON CAPABILITIES, LIMITATIONS, AND CORRECTNESS OF PETRI NETS. Report 26. Agerwala, T. (Johns Hopkins Univ., Baltimore, Md. (USA)). Jul 1973. Contract AT(11-1)-3288. 61p. Dep. NTIS $5.25.

Petri nets were one of the earliest contributions to the theory of parallel computations and appear to be a natural way to represent the coordination of asynchronous events. Petri nets, however, are not restricted to modelling coordinates in computer systems. Any system where there are loosely connected essentially independent processes that proceed in an asynchronous manner can be modelled using Petri nets and should be useful in modelling business systems and biological systems. (MCW)

7385 (EIR-243) TSCHEBYSCHEFF RATIONAL APPROXIMATIONS TO BICKLEY FUNCTIONS. Davierwalla, D. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1973. 69p. Dep. NTIS (U. S. Sales Only) $5.50.

The underlying theory and the construction of fast and accurate rational approximations to the Bickley functions are described. Continuous fractions are used to evaluate the approximations. (MCW)

7386 (EUR-5024) PLOTTY: AN INTERACTIVE PLOTTING PROGRAM FOR GRAPHS ON A TELETYPE BY MEANS OF THE SPC-16 MINI-COMPUTER. Eder, J.; Pagny, C. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Sep 1973. 53p. Dep. NTIS (U.S. Sales Only) $4.75. EUR B.Fr. 70.-.

A number of processors and utility subroutines were developed that permit the plotting of curves and graphs on a teletype. These programs run on a system with a minimum configuration; only a SPC-16 mini-computer and a standard teletype are required. Actually the routines are executed in an 8K-DBOS environment, however the limited versions can be used even on 4K stand-alone systems. The PLOTTY processor is interactive in the sense that parameters required for the execution are directly asked by the program and input after the response of the operator. Thus, this processor can be run by operators with little or no programming experience. (auth)

7387 (ORNL-4887) RANK ORDER PROBABILITIES: ONE-SAMPLE NORMAL SHIFT ALTERNATIVES. Part A: Table of Rank Order Probabilities. Lever, C. S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 191p. Dep. NTIS $7.60.

Let $X_1, \ldots, X_N$ be independent random variables normally distributed with mean θ and variance 1. The normal density function will be denoted by $f(x,\theta)$. If $x_1, \ldots, x_N$ are the observations and $y_1, \ldots, y_N$ are the absolute values of the observations arranged from smallest to largest, then $z = (z_1, \ldots, z_N)$ is defined to be the observed rank order where $z_i = 1$ if y_i is the absolute value of a positive number and $z_i = 0$ if y_i is the absolute value of a negative number. Corresponding to z is the random vector Z. There are 2^N possible values of Z and

$$P(Z = z|\theta) = N! \int_{0<u_1<\cdots<u_N<\infty} \cdots \int \prod_{i=1}^{N} f(u_i - (2z_i - 1)\theta)du_i.$$

Tables of $P(Z = z|\theta)$ to nine decimal places are presented for all z for $1 \le N \le 12$; $\theta = 0, .1, .2, .4, .6, .8, 1.0, 1.5, 2.0, 3.0$. Various applications of these tables are presented, including: (1) the small sample power of one-sample rank tests of symmetry such as the Wilcoxon signed rank test, the Fraser test, and the sign test against normal alternatives; (2) sequential one-sample procedures based on signed ranks and sums of signed ranks within groups with respect to normal alternatives. (auth)

7388 (RT/EDP-(73)3) MONOTONIC ITERATIVE METHODS FOR THE APPROXIMATE SOLUTION OF LINEAR ALGEBRAIC

SYSTEMS. Casadei, G.; Corradi, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 9 Jun 1973. 20p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.00.

Some monotone iterative methods are presented to solve systems of linear algebraic equations, with numerical applications to systems of Leontief-Minkowski type. (tr-auth)

7389 (SLA-73-871) DIGITAL FILTER DESIGN ROUTINES. Stearns, S. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

Three-digital filter design routines in FORTRAN for low-pass, high-pass, and band-pass filters are described. These routines produce Butterworth digital designs. Inputs are the 3-dB frequency (or frequencies), time step, and number of filter sections. Outputs are the filter coefficients and gain characteristics. Examples of use, analysis of performance, and program listings are provided. (auth)

7390 (SLA-73-5851) TRIPLE 6600 COMPUTER SYSTEM. Lemke, P. A.; Fishburn, J. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 45p. (CONF-731032-1). Dep. NTIS $4.25.

From VIM computer conference; Montreal, Canada (29 Oct 1973).

Design and development of a multi-mainframe 6600 based, computer system are presented. The system hardware shares a bank of 844 disk packs for data storage and ECS for control information. The discussion details the areas of the operating system requiring the most extensive modifications. Also, the completely new design of a permanent-file manager subsystem will be discussed. (auth)

7391 (SLA-73-5886) SANDIA ARTWORK LANGUAGE. A Tutorial Introductory Handbook. Mautino, V. L. (ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). 1 Oct 1973. 33p. Dep. NTIS $3.75.

Sandia Artwork Language (SAL) was developed to facilitate rapid conversion of artwork specifications into plotting codes for Sandia's Automatic Plotting Systems. The language is a simple precedence grammar allowing powerful calculation capabilities. Jobs may be run either from remote time-sharing teletypes or by normal batch methods. Output media include listings, punched paper tape, card decks, and magnetic tape. (MCW)

7392 (SU-326-P-18-X-6) SYSTEMS OPTIMIZATION PROJECT. Progress Report, 30 September 1972–30 June 1973. Dantzig, G. B.; Wilson, R. B.; Cottle, R. W.; Eaves, C. B. (Stanford Univ., Calif. (USA)). 1973. 22p. Dep. NTIS $3.25.

Activities of the Systems Optimization Laboratory (SOL) on the Project are described briefly. SOL has as its major purpose the development of computerized methods to analyze complex optimization problems of major importance in engineering design, long-range planning, and other activities. The goal is to provide users in the AEC and elsewhere with an array of powerful techniques, implemented in a complete package of computer routines, that are efficient and easy to use for solving major problems. (LMT)

7393 (UCID-30072) PROCEEDINGS OF CIE MEETINGS NO. 124 AND NO. 125: HOW THE NETWORK WORKS. Fletcher, J. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1972. Contract W-7405-eng-48. 37p. Dep. NTIS $4.00.

The OCTOPUS network is a superposition of subnetworks, and in the beginning the Head was a DEC PDP-6 and there were tentacles such as CDC 6600's, photostore, teletypes, etc. The operation was bundlesome to use, so the OCTOPUS was redesigned so as not to be one monolithic network but rather to be a superposition of subnetworks. Each subnetwork appeared like the original OCTOPUS. Each subnetwork does have a head called a concentrator. Attached to the concentrator are other computers and are called workers that run the user's problems. On the other side of the concentrator are whatever it needs: assorted storage, I/O gear, and/or terminals appropriate to whatever it is that the particular subnetwork is supposed to do. The ideal is one function for each subnetwork. Two subnetworks are described in detail. (MCW)

7394 COMPUTER SIMULATION MODEL OF REGIONAL ENERGY SYSTEMS. Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 17: 63-64(Nov 1973).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973). See CONF-731101-.

Miscellaneous

7395 (AREAEE-170) EXPERIMENTAL STUDY OF SHOCK WAVES GENERATED BY CONE ELECTRODE SOURCE. El-Khalafawy, T. A.; Masoud, M. M.; Zemoskov, A. I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 28p. Dep. NTIS (U.S. Sales Only) $3.50.

A quasi-stationary shock wave propagating in hydrogen at the pressure of 5 to 40 mtorr was experimentally analyzed, as well as the effect of a longitudinal magnetic field on the wave parameters. A supersonic flow of plasma free of the trapped fields was produced by a cone-electrode source. (auth)

7396 (BARC-651) SOLID-STATE RF MILLIVOLT METER. Lal, P. S.; Menon, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

A variety of millivolt meters are available but none of higher-input impedance. A millivoltmeter with an input impedance of 60 megohm shunted by a low capacitance and extremely low noise level using indigenous components is described. The millivoltmeter has full-scale deflection of 1 to 250 mV in 6 steps for accurate measurements in the frequency range of 20 Hz to 1 MHz (± 5% including meter accuracy and linearity) and usable well over 3 MHz (± 10%). The range of the meter can be extended up to 250 V by switching an attenuator at the input, which makes it an ideal voltmeter suitable for accurate measurements in volt and millivolt ranges where available voltmeters fail. (auth)

7397 (BNL-18215) CHARGE TRANSFER IN ALLOYS: THE BLIND MEN AND THE ELEPHANT. Watson, R. E.; Bennett, L. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 22p. (CONF-730563-1). Dep. NTIS $3.25.

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973).

An introduction is given to the concepts underlying the symposium. It also concentrates on the Moessbauer isomer shift and internal conversion experiments. (10 figures, 29 references) (auth)

7398 (BNL-18247) SOFT PHONON MODES IN $CsPbCl_3$. Yamada, Y.; Fujii, Y.; Hoshino, S.; Axe, J. D.; Shirane, G. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 10p. (CONF-730933-2). Dep. NTIS $3.00.

From third international meeting on ferroelectricity; Edinburgh, UK (10 Sep 1973).

Neutron scattering shows that phase transitions of $CsPbCl_3$ at 47, 42, and 37°C are associated with the condensation of rotational modes of $PbCl_6$ octahedra around the three principal axes. (auth)

7399 (BNL-18251) EVOLUTIONARY CHANGES IN GENOME AND CHROMOSOME SIZES AND IN DNA CONTENT IN THE GRASSES. Sparrow, A. H.; Nauman, A. F. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 30p. (CONF-730643-4). Dep. NTIS $3.50.

From symposium on basic mechanisms in plant morphogenesis; Upton, New York, USA (4 Jun 1973).

Nuclear volumes (NV) were determined from vegetative meristems of 76 acquisitions of grasses. Genome volumes (GV) and interphase chromosome volumes (ICV) were obtained by dividing NV by ploidy level or by chromosome number, respectively. DNA content per genome (DNA/G) and per chromosome (DNA/Ch) were estimated from the known relationship between NV and DNA content per nucleus (DNA/N). Among the grasses studied, there is a range in GV of nearly 20-fold, from 9 to 178 μm^3 (0.61 to 11.9 pg DNA/G). The range in NV is over 17-fold, from 71 to 1223 μm^3 (4.8 to 81.8 pg DNA/N), and ICV varies by a factor of almost 28, from 0.91 to 25.5 μm^3 (0.061 to 1.702 pg DNA/Ch). Ploidy level varies from 1x to 18x. (LMT)

7400 (BNL-18278) CALCITONIN IN THE TREATMENT OF OSTEOPOROSIS. Wallach, S.; Cohn, S. H.; Atkins, H. L.; Ellis, K. J.; Aloia, J. F. (Brookhaven National Lab., Upton, N. Y. (USA); State Univ. of New York, Brooklyn (USA). Downstate Medical Center). [nd]. 22p. (CONF-731037-1). Dep. NTIS $3.25.

From international symposium on the hormone calcitonin and its therapeutic applications; Milan, Italy (Oct 1973).

The present study provides documentation of a significant beneficial effect of synthetic salmon calcitonin (SCT) in combination with calcium supplementation in the treatment of spontaneous osteoporosis, and the results appear superior to other modalities that also act by inhibiting the rate of bone resorption. The superiority of SCT may reside in its more effective prolonged inhibition of bone resorption or in a decreased tendency of the rate of bone formation to decrease as a secondary response to the inhibition of bone resorption. The beneficial effects are maximal during the first year of treatment and do not lead to a restoration of normal skeletal mass. As a result, the risk of pathologic fractures and of future disability are lessened but not eliminated by SCT treatment. Therefore, a combination of effective inhibition of bone resorption by SCT with agents that independently stimulate bone formation deserves consideration in future therapeutic attempts to treat osteoporosis. (auth)

7401 (BNL-18295) FLUX OF WATER AND NUTRIENTS TO THE GROUND WATER UNDER A FIELD-TO-FOREST SERE. Ballard, J.; Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 14p. (CONF-730957-1). Dep. NTIS $3.00.

From IBP grassland biome symposium; Fort Collins, Colorado, USA (5 Sep 1973).

Nutrient elements are trapped and recirculated within ecosystems. Ecological theory suggests that the efficiency of trapping and recirculation in natural systems is a function of successional maturity; the more mature communities are more efficient. Initial data from a study of the experimental eutrophication of a terrestrial sere in central Long Island show that the theory is broadly correct. Forested lands hold nutrients tightly; agricultural lands are leaky. Porous soils and a high water table allow entire ecosystems to be used as lysimeters, with which ways are being explored of purifying waters and recirculating nutrients from sewage into useful pathways. (auth)

7402 (BNL-18296) TWO-COMPARTMENT CALCULATOR FOR THE DOG GLUCOSE POOL IN THE NONSTEADY STATE. Steele, R.; Rostami, H.; Altszuler, N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 98p. (CONF-730443-2). Dep. NTIS $7.00.

From 57th annual meeting of the Federation of American Societies for Experimental Biology; Atlantic City, New Jersey, USA (15 Apr 1973).

An analysis is presented of the one-compartment calculator previously used, and examples are given of its performance in situations where inflow and outflow rates are known. A two-compartment calculator is described, and examples are given of the much improved estimates of inflow and outflow that result from its use. In the two-compartment procedure, preliminary observations are made of plasma glucose specific activity in the steady state, and these are subjected to compartmental analysis. Elements of this two-compartment system are utilized to create the calculator for use in the nonsteady state. The whole procedure can be carried out by hand, using a desk-top machine. (LMT)

7403 (CEA-CONF-2294) PRECISION IN CORRELATION SPECTRAL ANALYSIS. Boureux, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 11 Jan 1973. 22p. (In French). (CONF-721152-1). Dep. NTIS (U. S. Sales Only) $3.25.

From meeting on the utilization of filtering in geophysics; Lyon, France (18 Nov 1972).

7404 (CEA-CONF-2295) SOME ASPECTS OF THE ACTUAL SITUATION IN THE USE OF FILTRATION BY CORRELATION. Chabert, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 12 Dec 1972. 8p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

7405 (CEA-CONF-2305) MEASUREMENT OF THE IMPULSE RESPONSE OF A HUMAN OPERATOR BY THE METHOD OF THE PURSUIT TEST. Max, J.; Garrel, S. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 4 Jul 1972. 13p. (In French). (CONF-720697-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on electroencephalography and clinical neurophysiology; Lyon, France (9 Jun 1972).

7406 (CEA-CONF-2321) IMPROVEMENT CYCLE FOR ELECTRON MICROPROBE ANALYSIS. Maurice, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). Apr 1973. 24p. (In French). Dep. NTIS (U.S. Sales Only) $3.25.

7407 (CEA-CONF-2329) ELECTRONIC BAKING OF PAINTS AND VARNISHES. Puig, J. R.; Gaussens, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). 21 Mar 1973. 19p. (In French). (CONF-730348-1). Dep. NTIS (U.S. Sales Only) $3.00.

From meeting of European Coil Coating Association; Paris, France (23 Mar 1973).

The usefulness of this procedure in comparison with thermal baking (economic aspects, absence of pollution, safety aspects) is discussed. Developments in such techniques will be made possible by a constant enrichment and improvement of the radiohardenable binders used. (FR)

7408 (CEA-CONF-2359) USE OF SILICON STRUCTURES ON INSULATORS TO MAKE INTEGRATED MOS CIRCUITS. Borel, J.; Suat, J. P.; Bernard, J.; Garcia, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 13 Feb 1973. 33p. (In French). (CONF-730132-2). Dep. NTIS (U.S. Sales Only) $3.75.

From meeting on SEE studies on recent progress in MOS technology; Malakoff, France (24 Jan 1973).

7409 (CEA-CONF-2360) ELECTROOPTICAL CHARACTERISTICS OF A DISPLAY CELL OF THE TWISTED NEMATIC TYPE. Monolithic Display by a Nematic Liquid Crystal on an Integrated Control Circuit. Borel, J.; Robert, J.; Garadjedaghi, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 3 Mar 1973. 13p. (In French). (CONF-730469-1). Dep. NTIS (U.S. Sales Only) $3.00.

From international colloquium on alpha numeric devices and display systems; Paris, France (9 Apr 1973).

7410 (CEA-CONF-2374) SURFACE WAVES ON THE (001) FACE OF A FACE-CENTERED CUBIC CRYSTAL IN THE PRESENCE OF AN ADSORBED MONOLAYER. Armand, G.; Theeten, J. B.; Lejay, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 5 Apr 1973. 9p. (In French). (CONF-730567-1). Dep. NTIS (U. S. Sales Only) $3.00.

From colloquium on the physics and chemistry of surfaces; Brest, France (23 May 1973).

Frequencies and polarizations are theoretically determined of surface waves propagating on the (001) surface of a fcc crystal covered with an adsorbed monolayer of P (1×1) structure. Forces between atoms are assumed harmonic and of central type, and restricted to nearest-neighbour interaction between every atom. Moreover, next-nearest neighbours interaction in the adsorbed layer are introduced. Results are discussed for the [100] direction in function of the mass of the adsorbed atoms and of the different force constant introduced in the model. (auth)

7411 (CEA-CONF-2412) MEASUREMENTS OF THE FUNCTIONS OF AMBIGUITY FOR THE IDENTIFICATION OF NON-HOMOGENEOUS LINEAR SYSTEMS. Garderet, P.; Max, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 5 Jun 1973. 14p. (In French). (CONF-730664-1). Dep. NTIS (U.S. Sales Only) $3.00.

From international symposium on information theory; Ashkelon, W. Palestine, Israel (25 Jun 1973).

7412 (CEA-CONF-2429) COMPENSATION BY CORRELATION OF SPIN SIGNAL ON BOARD THE GEOS SATELLITE. Chevalier, H.; Max, J.; Dominiak, M.; Lesage, H.; Kofman, W.; Taveaux, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 23 Mar 1973. 15p. (In French). (CONF-730572-2). Dep. NTIS (U.S. Sales Only) $3.00.

From 4th colloquium on the processing of the signal and its applications; Nice, France (7 May 1973).

7413 (CEA-CONF-2431) NEW ANALOG INTEGRATED MOS CIRCUITS AND TREATMENT OF THE SIGNAL. Audaire, L.; Borel, J.; Poujois, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 19 Mar 1973. 18p. (In French). (CONF-730572-1). Dep. NTIS (U.S. Sales Only) $3.00.

From 4th colloquium on the processing of the signal and its applications; Nice, France (7 May 1973).

7414 (CEA-CONF-2440) METHODS OF REGISTRATION OF EYE MOVEMENTS. Masse, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 16 May 1973. 13p. (In French). (CONF-730569-1). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on visual perception and man-machine systems; Lille, France (2 May 1973).

7415 (CEA-N-1660) FORMULAS FOR SINGLE-PHASE CONVECTION HEAT EXCHANGES: EFFECT OF GEOMETRY, PHYSICAL PROPERTIES, AND METHOD FOR IMPROVING THE HEAT EXCHANGE. Lafay, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Apr 1973. 56p. (In French). Dep. NTIS (U. S. Sales Only) $5.00.

Essential results on heat transfer by forced and natural convection in a single phase fluid are presented. The different modes of convection are defined and dimensional parameters, each of which characterize classical empirical and semiempirical correlations with their limits of application for parallel and transverse flows in laminar and turbulent regimes are introduced. These parameters apply to completely developed flows and to those being established and also to various geometry channels (circular, annular, rectangular). Some special problems concerning the effect of the variation in the physical properties of

the fluid with temperature are exposed together with the methods used to increase the heat transfer. A bibliography is presented enabling references to be made to the specialized publications and literature necessary to completely understand each case studied. (FR)

7416 (CEA-R-4518) CONTRIBUTION TO THE STUDY OF SOLID STATE DIFFUSION IN CONCENTRATED ALLOYS: A CASE STUDY OF THE Fe–Pd SYSTEM. Gomez Jaen, J. P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 221p. (In French). Dep. NTIS (U.S. Sales Only) $13.25.
Thesis.

7417 (CONF-730565-1) SAFETY FACTORS AND REPAIR TURNOVER IN NA–K TRANSPORT SITES OF HeLA CELL MEMBRANES. Cook, J. S. (Oak Ridge National Lab., Tenn. (USA)). 1973. 6p. Dep. NTIS $3.00.
From fourth international conference on theoretical physics in biology; Versailles, France (28 May 1973).

7418 (CONF-730833-2) PHOTOIONIZATION OF FREE RADICALS. Berkowitz, J. (Argonne National Lab., Ill. (USA)). 1973. 18p. Dep. NTIS $3.00.
From chemical spectroscopy and photochemistry in the vacuum ultraviolet conference; Valmorin, Quebec, Canada (5 Aug 1973).

7419 (CONF-730966-1) RADIOANGIOCARDIOGRAPHY IN CONGENITAL HEART DISEASES. Dietrich, R.; Sanchez, J.; Lanaro, A. E.; Pico, A. M. (Puerto Rico Nuclear Center, Mayaguez). 1973. 8p. (In Spanish). Dep. NTIS $3.00.
From 23rd annual meeting of the Puerto Rican Heart Association; San Juan, Puerto Rico (22 Sep 1973).

7420 (CONF-730967-1) STRUCTURAL INTERPRETATION OF SHORT-RANGE ORDER. Das, S. K.; Thomas, G. (Argonne National Lab., Ill. (USA)). 1973. 13p. Dep. NTIS $3.00.
From international symposium on order-disorder transformations in alloys; Tubingen, F.R. Germany (3 Sep 1973).
The various structural models of short-range order in alloys are briefly reviewed. The success and limitations of structural models in interpreting diffuse scattering data are discussed. Particular emphasis is given on the systems for which the diffuse short-range-ordered maxima in the x-ray and electron-diffraction patterns are noncoincident with the position of the superlattice reflections. The recent electron-diffraction results on these systems suggest microdomains with different superstructures to be present in the short-range-ordered state. The justification for such multiple microdomain configurations is discussed in the light of some recent theoretical developments. (43 references) (auth)

7421 (CONF-731113-3) MASS SPECTROMETRIC STUDIES OF N-NITROSO COMPOUNDS. Rainey, W. T.; Christie, W. H.; Lijinsky, W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 7p. Dep. NTIS $3.00.
From American Chemical Society 25th annual southeastern regional meeting; Charleston, South Carolina, USA (7 Nov 1973).

7422 (CONF-731118-1) COMPUTER-OPERATED QUARTZ DIFFERENTIAL DILATOMETER. Kollie, T. G.; McElroy, D. L.; Hutton, J. T.; Ewing, W. M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 30p. Dep. NTIS $3.50.
From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973).
A quartz differential dilatometer was interfaced with a Digital Equipment Corporation PDP-8 computer to automatically measure the thermal expansion of solids from 300 to 1000 K. A Carson-Dice Electronic-Mechanical Micrometer, readable to 2.5×10^{-4} cm, was employed for length-change measurements accurate to 2.5×10^{-5} cm. Calibrated $Pt/Pt_{90}Rh_{10}$ thermocouples were used to measure temperature changes to ±0.22 K. The software and hardware necessary to completely automate the measurements are described. Measurements on National Bureau of Standards certified quartz, tungsten, and copper specimens demonstrated an accuracy of ±1.5% in determination of the coefficient of thermal expansion. (auth)

7423 (CONF-731205-1) THE WHAT SYSTEM: A NEW DIGITIZED RADIOSONDE AND DOUBLE THEODOLITE BALLOON TRACKING SYSTEM FOR ATMOSPHERIC BOUNDARY LAYER INVESTIGATIONS. Frenzen, P.; Prucha, L. L. (Argonne National Lab., Ill. (USA)). 1973. 9p. Dep. NTIS $3.00.
From American Chemical Society 2nd joint conference on sensing of environmental pollutants; Washington, District of Columbia, USA (10 Dec 1973).
A semiautomatic system for obtaining measurements of wind and temperature through the lower several kilometers of the atmosphere with improved resolution and accuracy was developed. Two manually operated theodolites were equipped with high-resolution, pulse-type shaft encoders directly coupled to the elevation and azimuth axes of each instrument. Associated digital electronic and incremental tape equipment automatically records the four sighting angles in computer compatible form at preset intervals, as often as once each second. Balloons tracked for winds also carry transistorized radiosonde transmitters whose continuous temperature signals are recorded on the incremental tape along with the tracking data. A computer program subsequently averages several successive sets of sighting angles to smooth operator tracking errors, and calculates average winds, heights, and temperatures (hence the acronym), typically over periods of 10 to 20 seconds or through atmospheric layers 25 to 50 m thick. The system is fully portable and can be operated with storage batteries in the field. (auth)

7424 (COO-716-84) INVESTIGATION OF SOME LANTHANIDE CARBON, NITROGEN, CHALCOGEN, AND HALOGEN SYSTEMS AT ELEVATED TEMPERATURES. Progress Report, February 1, 1973–January 31, 1974. Eick, H. A.; Luke, H.; Biefeld, C. G.; Biefeld, R. M.; Clink, B. L.; Richards, J. T. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-716. 24p. Dep. NTIS $3.25.
Progress is reported on studies of the thermodynamic characterizations of the sublimation and vaporization reactions of YbF_2 and UbF_3, and preparation phase studies of mixed halides of europium, ytterbium chloride, and lanthanide(III) fluorides. (DHM)

7425 (COO-1198-1020) NMR STUDY OF THE ELECTRON SPIN DENSITY NEAR IRON-GROUP ATOMS IN Cu. Boyce, J. B.; Aton, T. J. (Illinois Univ., Urbana (USA)). 1973. Contract AT(11-1)-1198. 5p. (CONF-731104-4). Dep. NTIS $3.00.
From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).
Observations are reported on the nuclear resonances of Cu atoms which are near neighbors to 6 of the 3d transition element impurities in dilute Cu alloys. These systems are of interest in the Kondo problem. The resonances appear as satellites split from the strong resonance of the distant Cu atoms. Their splittings yield the magnitude and spatial shape of the conduction electron spin magnetization. One shell of neighbors to Ni, two to V, three to Co, four to Cr and Mn, and five to Fe were observed. The satellite in CuNi was studied at liquid helium temperatures in fields from 6 to 60 kG and those in CuCo from 1.5 to 450°K and 6 to 63 kG. Results of studies on CuV from 8 to 63 kG at liquid helium temperatures, CuCr and CuMn from 7 to 15 kG at 300°K, and CuFe from 7 to 61 kG and 77 to 330°K are also reported. The satellite positions are independent of concentration from about 500 to 5000 ppM. The usual theoretical expressions for spin density are evaluated far from the impurity, where they depend only on the electrons at the Fermi surface. In contrast, to treat the near neighbors a d-wave phase-shift analysis was developed in which conduction electrons of all energies are included to fit the experimental splittings in both the magnetic and nonmagnetic cases. (auth)

7426 (COO-1469-233) BEACON: A LIGHT EMITTING DIODE TELEVISION DISPLAY. Jer, M. M. T. (Illinois Univ., Urbana (USA). Dep. of Computer Science). Sep 1973. Contract AT(11-1)-1469. 26p. (UIUCDCS-R-73-591). Dep. NTIS $3.50.
Thesis.

7427 (COO-2013-22) CONGENITAL MALFORMATIONS: THE INFLUENCE OF GENETIC AND NONGENETIC FACTORS. Progress Report, January 1, 1973–December 31, 1973. Woolf, C. M. (Arizona State Univ., Tempe (USA)). 1973. Contract AT(11-1)-2013. 33p. Dep. NTIS $3.75.
Before the etiological role of mutation can be evaluated for congenital malformations, it is necessary to obtain this information. During this contract period (1973), data were collected on (1) the incidence of congenital hip disease in the San Carlos Apache Indians, (2) the sex ratio of individuals with Type I syndactyly, and (3) the frequency of spontaneous abortions and stillbirths in control families for spina bifida cystica. (auth)

7428 (COO-2203-2) CRITICAL SCATTERING OF LASER LIGHT BY THIN FLUID FILMS. Progress Report. Mockler, R.; O'Sullivan W. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1973. Contract AT(11-1)-2203. 15p. Dep. NTIS $3.00.
A novel close-spaced Fabry–Perot interferometer has been developed that contains the fluid under study between the mirrors. The interferometer-cell has been used to make the first successful measurement of the anomalous refractive index of a binary fluid mixture near its consolute critical point. The cell has also been used to determine the coexistence curve for a binary mixture and the associated critical index β. Intensity

autocorrelation spectroscopy of laser light scattered from Brownian particles suspended in a binary mixture has been used to study the effective shear viscosity of the fluid near its critical point. A theory has been developed that includes a momentum-dependent shear viscosity and takes into account effects due to surface interactions between the particles and the fluid. This theory explains the observations and is consistent with the results of earlier tracer-diffusion measurements in a critical mixture. (auth)

7429 (COO-3110-10) MUTAGENESIS OF HAPLOID CULTURED FROG CELLS. Mezger-Freed, L. (Institute for Cancer Research, Philadelphia, Pa. (USA)). 1973. Contract AT(11-1)-3110. 30p. (CONF-730829-1). Dep. NTIS $3.50.

From 13th international congress of genetics; Berkeley, California (20 Aug 1973).

Haploid cells afford an opportunity to test some of the assumptions from bacterial genetics which have been adopted by somatic cell geneticists. Haploid cultured cell lines derived from the grass frog Rana pipiens were compared to diploid cell lines in order to test a model which predicts that recessive mutations will be expressed in diploid cells with a frequency equal to the square of that in haploid cells. Haploid and diploid monolayer cultures were compared for (1) survival after exposure to compounds known to be mutagenic for bacteria (a measure of the frequency with which lethal mutations are expressed), and (2) the induction of drug-resistant variants (putative mutants) by such compounds. The proportion of cells that survived from diploid cultures was no more than ten times that from haploid cultures, a much smaller difference than predicted. Furthermore, the frequency of drug-resistant variants was independent of ploidy. (auth)

7430 (COO-3150-17) COMMENT ON "MODEL FOR THE ANALYSIS OF THE MAGNETORESISTANCE IN POTASSIUM" AND "HIGH- AND LOW-FIELD LIMITS FOR THE HALL COEFFICIENT OF POTASSIUM". Garland, J. C.; Maxfield, B. W.; Penz, P. A.; Taub, H.; Wagner, D. K. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). 1973. Contract AT (11-1)-3150. 8p. Dep. NTIS $3.00.

The two letters (entitled as above) have been recently published by J. Babiskin and P. G. Siebenmann (Phys. Rev. Lett., 27:1361 (1971) and 30:380(1973)). These two letters account for the puzzling linear magnetoresistance of potassium in terms of macroscopic inhomogeneities present in the potassium specimens. The authors of this report express serious reservations about the validity of this explanation and comment on the letters in the light of presently published experimental results on potassium. (MCW)

7431 (COO-3214-4) PROGRESS REPORT ON RESEARCH ON HUMAN GENETICS IN ICELAND. (Iceland Univ., Reykjavik). 30 Apr 1973. Contract AT(11-1)-3214. 80p. Dep. NTIS $6.00.

7432 (COO-3223-19) FINAL TECHNICAL REPORT, AUGUST 15, 1971–AUGUST 14, 1972. Raper, J. R.; Hoffman, R. M. (Harvard Univ., Cambridge, Mass. (USA). Dept. of Biology). 1972. Contract AT(11-1)-3223. 5p. Dep. NTIS $3.00.

Work to date on mutations of the incompatibility factors and other genes affecting their expression in Schizophyllum commune is briefly summarized. A second line of research, biochemical consequences of development in Schizophyllum, is also briefly reported. Four separate papers have been published to date on work under the contract. (LMT)

7433 (COO-3573-6) FATE OF METALS IN ESTUARIES. Turekian, K. K. (Yale Univ., New Haven, Conn. (USA). Dept. of Geology and Geophysics). 1972. 3p. (CONF-721106-7). Dep. NTIS $3.00.

From 65th annual meeting of the American Institute of Chemical Engineers; New York, New York, USA (26 Nov 1972).

The habitation of man has increased the total metal, as well as organic matter, concentration of Long Island Sound in the last 120 years as is clearly shown in sediment cores and in salt marsh deposits. Similar increases have been reported in coastal deposits in other parts of the world. There is evidence that, however the metals reached the sediments, the release back into solution is virtually nil for those elements not forming highly soluble anion complexes in low-oxygen bottom waters. Indeed the only element known to be released from sediments in Long Island Sound is uranium (probably released after the formation of $UO_2(CO_3)_3^{-4}$ at the sediment/water interface). (LMT)

7434 (DP-MS-73-53) EFFECT OF TRAPPING ON HYDROGEN PERMEATION IN COPPER. Caskey, G. R. Jr.; Pillinger, W. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 19p. (CONF-730922-2). Dep. NTIS $3.00.

From international conference on hydrogen embrittlement effect on metal properties selection and design; Champion, Pennsylvania, USA (23 Sep 1973).

Results of permeation experiments with high-purity copper in a deuterium atmosphere suggest that reversible trapping of deuterium occurs. Deuterium permeation was measured at temperatures between 270 and 450°C. A mathematical model, based on the general diffusion-plus-trapping model of McNabb and Foster, was developed to predict trap densities. Solutions were obtained for a plane sheet by the finite-difference method and are convergent and stable over a relatively wide range of parameters. Experimental results agree qualitatively with predictions of the model. (auth)

7435 (GAT-707) STUDIES OF THE NICKEL-RICH NICKEL–ALUMINUM ALLOY SYSTEM. Thomas, H. H.; Storms, L. E.; Elcess, M. O. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 26 Oct 1973. Contract AT(33-2)-1. 23p. Dep. NTIS $4.00.

The corrosion resistance of plasma-sprayed Ni–Al alloy coatings in fluorine was studied at 240 to 400°C for various compositions. The exothermic Ni–Al reaction was also examined. X-ray diffraction data for Ni_3Al was resolved with that in literature. (DLC)

7436 (GKSS-73/E/15) AMMONIA AS MODIFYING AGENT FOR CELLULOSE ACETATE MEMBRANES. Boeddeker, K. W.; Kaschemekat, J.; Woldmann, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F. R. Germany)). 1973. 10p. (CONF-730904-5). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth international symposium on fresh water from the sea; Heidelberg, F. R. Germany (9 Sep 1973).

Asymmetric cellulose acetate membranes for desalination by reverse osmosis may be prepared using anhydrous ammonia, incorporated by absorption at room temperature, as modifying additive. Membrane performance is comparable to that of formamide-modified membranes, at a considerably lower level of initial additive concentration. (auth)

7437 (INP-832) INVESTIGATION OF EUROPIUM COMPOUNDS BY MEANS OF THE MOESSBAUER SPECTROSCOPY. Gerlikh, E.; Lontka, K.; Tomalya, K.; Khrynkevich, G.; Kmets, R.; Eliseev, A. A.; Sadovskaya, O. A.; Torbova, O. D.; Torbov, V. P.; Chukalin, V. I. (Institute of Nuclear Physics, Krakow (Poland)). Apr 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The isomer shift values of the following europium compounds EuP, EuS(48%S), EuS(54%g), Eu_3S_4 and Eu_4S_7 were investigated. The 21.4 keV gamma transition in ^{151}Eu was used in the Mössbauer measurements. (auth)

7438 (K-1846) DEVELOPMENT, IMPLEMENTATION, AND EFFECT OF A PREVENTIVE MAINTENANCE SCHEDULING SYSTEM IN AN INDUSTRIAL PLANT. Byars, W. S. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 19 Nov 1973. Contract W-7405-eng-26. 120p. Dep. NTIS $8.00.

Thesis.

A study was made of both the theoretical approach and the practical industrial approach to develop a preventive maintenance (PM) system for an industrial job shop environment. In many industries the data necessary for the theoretical approach is not available, and it is too costly to obtain prior to setting up a PM program. A system was developed that attempts to blend the analytical approach with the practical industrial approach in order to minimize maintenance costs by adjusting PM frequencies as a function of machine breakdowns and machine usage. A computer was used to schedule repetitive PM tasks and level workloads according to given criteria. A data collection system was developed, and information from the system was used to adjust PM frequencies toward optimum intervals to minimize total maintenance costs. (auth)

7439 (KFK-EXT-8/73-1) REGENT THIRD SEMIANNUAL PROGRESS REPORT, OCTOBER 1972–MARCH 1973. Enderle, G.; Leinemann, K.; Olbrich, W.; Schlechtendahl, E. G.; Schumann, U.; Schuster, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. 43p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

The project REGENT (German acronym for CAD, Computer-aided design) was started early 1972 by the Institut fuer Reaktorentwicklung. This report summarizes the results achieved in the areas of: application of ICES (Integrated Civil Engineering System), graphic data processing, a new ICES subsystem UTILITY, and the basic concept of the REGENT system nucleus. (auth)

7440 (LA-5373-MS) IMPROVEMENTS IN HOT-WIRE ELECTROEXPLOSIVE DEVICES. Joppa, R. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 19p. Dep. NTIS $4.00.

Several possible design improvements in hot-wire electroexplosive devices were investigated. These were: an arc-resis-

tant header, greater bridgewire-post heat dissipation area, reacting metal bridgewires, and a secondary explosive substitute for primary explosive. Tests using an SE-1 test fixture with four header-bridgewire models showed highly promising results for raising the overall hot-wire ignition safety margins in electrostatic and rf environments without large increases in firing energy. Various electrical characteristics of the four models are given, together with electrical characteristics and function times of the devices loaded with the secondary explosive. (auth)

7441 (LA-5422-MS) VERSATILE ROCK-MELTING SYSTEM FOR THE FORMATION OF SMALL-DIAMETER HORIZONTAL GLASS-LINED HOLES. Sims, D. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

Rock-melting penetrators with diameters ranging from 50 mm (2 in.) to 76 mm (3 in.) have reached a stage of development at the Los Alamos Scientific Laboratory (LASL) which suggests that these devices are ready for practical application. Prototype refractory metal penetrators have formed glass-cased vertical holes of 26 m (82 ft) in a single run, and horizontal holes with diameters up to 127 mm (5 in.) are expected in the near future. These small horizontal holes can be used for underground utility conduits; for high-explosive shot emplacement; and as drainage holes to stabilize road cuts or embankments. Design concepts and preliminary specifications are described for a Subterrene system that forms small-diameter horizontal holes in rock by melting and simultaneously lines the hole with glassy rock melt. Most components of the system are commercially available. Deviation sensors and alignment-control units can be added to ensure that the holes are straight. The design and operation of this Subterrene system are described and proposed development approaches for the hole-forming assembly are discussed. (auth)

7442 (LBL-1899) SOME APPLICATIONS OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO INORGANIC MATERIALS. Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 13p. (CONF-730831-2). Dep. NTIS $3.00.

From 3rd international conference on high voltage electron microscopy; Oxford, UK (27 Aug 1973).

Research programs currently being carried out using the 650 kV Hitachi electron microscope is summarized. Many of the programs are interdisciplinary in nature, and involve projects in biology, natural sciences, and engineering. The biological work is described and examples of current work on contrast, resolution, and applications in ceramics and minerals are outlined. One of the main advantages of HVEM for crystals is increased penetration and resolution. Apart from studies of knock-on radiation damage and organic (biological) materials, 1 MeV appears to be optimum for research in inorganic materials. (auth)

7443 (LBL-1973) GEOMETRY OF SOME METAL HALIDES. Yarnell, P. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 202p. Dep. NTIS $12.25.

Thesis.

Two polarizable ion models are developed to describe the gas phase of metal dihalide molecules. Both models use electrostatic and repulsive interactions to predict molecular geometries and molecular constants. The first model is applied to the dihalides of the alkaline earths, group II-b metals, transition metals, group IV-a metals, and europium. In addition to the molecular geometry, bending frequencies are derived for most of these molecules. The second or "linear" model is applied to the alkaline earth dihalides; equilibrium internuclear bond lengths, stretching force constants, and stretching frequencies are determined. (LK)

7444 (LBL-2045) EFFECTS OF REVERSIBLE DENATURANTS ON THE PHOTOSYNTHETIC CELL MEMBRANE, PIGMENTS AND SUBSTRUCTURE, OF R. SPHEROIDES. Ruben, G. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1972, Contract W-7405-eng-48. 259p. Dep. NTIS $15.00.

Thesis.

The photosynthetic apparatus in the membranes was investigated with the reversible structural denaturants octanoic acid and methyl octanoate. Characterization of the effects of these denaturants on biochemically isolated preparations with optical techniques made it possible to correlate and interpret the electron-microscope results. In situ denaturation and its reversibility made it possible to relate the denaturant-caused membrane changes to the original in vivo structure. The limitations of platinum–carbon shadowing for quantitative measurements of inner-membrane particles are defined. Evidence for the molecular basis of the diversity of near-infrared in vivo Bchl absorbance peaks is presented. An inner-membrane particle is identified and other possible candidates are outlined. (auth)

7445 (LBL-2054) BUNDLE SHEATH AND MESOPHYLL CHLOROPLASTS OF C_4 PLANTS: AN IN SITU COMPARISON OF THEIR ROOM-TEMPERATURE FLUORESCENCE. Elkin, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 334p. Dep. NTIS $18.75.

Thesis.

7446 (LBL-2167) PROTEIN: THE FABRIC OF MEMORY. Flood, J. F. II. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 196p. Dep. NTIS $12.00.

Thesis.

Inhibitors of cerebral protein synthesis were employed to investigate the role of protein synthesis in memory formation. Cycloheximide, acetoxycycloheximide, and anisomycin, inhibitors of protein synthesis, were employed in studies of inhibition of brain protein synthesis and in studies of learning and memory in mice. (LMT)

7447 (ORNL-NSF-EATC-2) MULTI-SOURCE ATMOSPHERIC TRANSPORT MODEL FOR DEPOSITION OF TRACE CONTAMINANTS. Mills, M. T.; Reeves, M. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $6.25.

An Atmospheric Transport Model (ATM) from a Gaussian plume model was developed to calculate the toxic material deposition rate at any point within a watershed, given the location of various air pollution sources. Sources presently include the point source (stack), area source (city), line source (road or railbed), and windblown source (dry tailings pond). These rates are then used by the Wisconsin Hydrological Transport Model (WHTM) to determine the subsequent transfer of the toxic materials to the stream and groundwater. (auth)

7448 (ORNL-TIRC-73-13) BIOLOGICAL EFFECTS OF SACCHARIN. A Bibliography. Warren, H. S. (Toxicology Information Response Center, Oak Ridge, Tenn. (USA)). Jun 1973. 24p. Dep. NTIS $6.00.

This bibliography of 118 references on the biological effects of saccharin, including sodium, calcium, and ammonium salts. Topical subjects interacted with saccharin and salts for inclusion in the search were pharmacodynamics, carcinogenicity, mutagenicity, and toxicity. Behavioral studies were omitted unless other biological effects were indicated. Analytical procedures for detecting saccharin and salts were included only when determinations were made on biological materials. Coverage of the literature spans the time period from 1967 to April 1973 inclusive. (LMT)

7449 (ORO-3913-4) ENZYME SEPARATION BY PARAMETRIC PUMPING. Progress Report, June 1, 1971 – September 30, 1972. Shaffer, A. G. Jr.; Hamrin, C. E. Jr. (Kentucky Univ., Lexington (USA). Coll. of Engineering). 1972. Contract AT(40-1)-3913. 65p. Dep. NTIS $5.25.

Thesis. Submitted by A. G. Shaffer, Jr.

Parametric pumping is a relatively new separatory technique in which a mobile fluid phase is allowed to pass back and forth over an adsorbent bed while a system parameter is synchronously varied. This adsorbent bed preferentially adsorbs one solute from the mobile phase, with this adsorption being a function of the system parameter which is varied. In this way, the solute is removed from the mobile phase. Work in this field has previously been limited to chemical species. In this series of experiments, an enzyme, trypsin, was removed from an aqueous solution by adsorption on chicken ovomucoid covalently bonded to Sepharose 4B beads, while the system underwent a synchronous pH change. (auth)

7450 (ORO-4314-2) MOESSBAUER SPECTROSCOPY OF BIOCHEMICALS CONTAINING IRON. Progress Report No. 7, October 1, 1969–September 30, 1973. May, L. (Catholic Univ. of America, Washington, D. C. (USA). Dept. of Chemistry). 1 Oct 1973. Contract AT(40-1)-4314. 57p. Dep. NTIS $5.00.

The purpose of this research is to utilize Mössbauer spectroscopy to study the structure of various hemoenzymes and hemoproteins and their relationship to biological activity. Initially, two hemoenzymes were selected: catalase and cytochrome c. To assist in the interpretation of the Mössbauer spectrum of cytochrome c, a study of the model compound, the undecapeptide, was made. This past year, cytochrome f was isolated from Euglena grown in a medium enriched with ^{57}Fe. This protein is very similar to cytochrome c in its physical properties and is more easily enriched than cytochrome c. Another enzyme involved in drug and steroid oxidation, cytochrome P-450, is also being investigated.

Also, a series of monomeric hemoglobins have been examined. These were selected because there had been studies made on the optical spectra and the electron spin resonance spectroscopy to which the Mössbauer parameters could add information concerning the state of the iron in these molecules. The Mössbauer spectrum of the bacteria, Hydrogenomonas Facilis, was also initiated to determine the usefulness of this technique in the study of the role of iron-containing proteins in this bacteria. The computer program for fitting the Mössbauer spectra has been translated into the Fortran IV language used by the PDP-10. (auth)

7451 (RFP-2148) SPECIMEN MOUNTING METHODS FOR METALLOGRAPHY. Miley, D. V.; Calabra, A. E. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1973. 68p. Dep. NTIS $5.50.

The development of metallographic mounting methods is reviewed and several of the more common methods being used are discussed. Characteristic advantages and disadvantages are pointed out. Retention of sample edges for examination is essential in many investigations, and a separate section is devoted to the many techniques devised to achieve this goal. It is noted that there is a mounting technique available for virtually any type of specimen. (14 figures, 6 tables, 57 references) (JRD)

7452 (RISO-280) THEORY OF TRANSIENT HOT-WIRE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF ELECTROLYTIC SOLUTIONS. Baruel, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 75p. Dep. NTIS (U. S. Sales Only) $5.75.

Theoretical foundations underlying a modification of the transient hot-wire method of measurement of the thermal conductivity of liquids are presented. The modification, now used with full automation, allows the method to be used also for electrolytic solutions. (DE)

7453 (RT/EDP-(73)4) PROGRAM FOR THE CALCULATION OF FLOW NETWORKS. Barozzi, G. C.; Casadei, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 May 1973. 17p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.00.

7454 (SLA-73-365) PROPERTIES OF SILICONES, POLYURETHANES, AND STRUCTURAL EPOXY ADHESIVES. DeLollis, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

Engineering information was compiled for urethanes, silicones and structural adhesives. Data are presented for urethane bonds to aluminum with and without primer, for silicone adhesive sealant moduli at various temperatures for different cures, and for structural epoxy adhesive bonds to aluminum after two years' exposure to a variety of conditions involving water and temperature. (8 tables) (auth)

7455 (SLA-73-729) DEVELOPMENT AND EVALUATION OF A COMPACTED CVD/FELT CONE. Granoff, B.; Apodaca, M. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. Contract AT(29-1)-789. 71p. Dep. NTIS $5.75.

A technique has been developed for the wrinkle-free compaction of a viscose–rayon felt cone. The compacted cone, along with a noncompacted cone, was densified by means of isothermal chemical vapor deposition (CVD) of carbon. The compacted (carbon-matrix/carbon-fiber) CVD/felt cone had a significantly higher longitudinal tensile strength and modulus than the similarly infiltrated noncompacted material. Compaction resulted in a decrease in the perpendicular thermal conductivity and an increase in the perpendicular thermal expansion. These property changes have been rationalized in terms of (1) fiber and matrix reorientations, and (2) changes in porosity. Based on the mechanical and thermal properties, the compacted CVD/felt is expected to have a lower thermal stress resistance than the state-of-the-art noncompacted material. Therefore, further development work on the compacted CVD/felt is not recommended. (21 figures, 19 references) (auth)

7456 (SLA-73-874) STUDY OF MECHANICAL RESONANCE IN THE TME-16 TRACKING TELESCOPE BY EXAMINATION OF THE CONTROL FEEDBACK LOOP. Howard, R. S.; Shaut, A. L.; Bechtel, F. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. 38p. Dep. NTIS $4.00.

This report documents the procedures used to resolve a mechanical resonance problem in the elevation axis drive system as observed in the tachometer feedback loop of the TME-16 optical tracking mount. Because this type of problem can be expected in other similarly configured control systems, the theoretical and experimental work performed to study and correct the problem may be useful for future reference. (auth)

7457 (SLA-73-886) CERAMIC SUBSTRATES FOR HYBRID MICROCIRCUIT APPLICATIONS. Knutson, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. Contract AT(29-1)-789. 85p. Dep. NTIS $6.25.

The various investigations undertaken and the test procedures developed to evaluate high-density unglazed alumina substrates for use in thin-film hybrid microcircuit applications are summarized. In addition to obtaining an increased understanding of substrate material, this project culminated in the publication of an official Sandia material specification. A fairly detailed explanation of certain aspects of the specification is also included. (auth)

7458 (SLA-73-986) HIGH-TEMPERATURE COMPENSATION OF STRAIN MEASUREMENTS. Davis, D. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 16p. Dep. NTIS $3.00.

A method was developed to compensate for the changes that occur in outputs of strain gages when they are subjected to high temperatures. The technique involves the use of thermocouples subjected to the same temperature profile as those for the strain gages. (auth)

7459 (SLA-73-5795 and A) SURFACE-STRUCTURE DETERMINATION BY LOW-ENERGY ELECTRON DIFFRACTION. Duke, C. B.; Lipari, N. O.; Laramore, G. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 40p. (CONF-730940-1). Dep. NTIS $4.00.

From conference on perspectives for the calculation on the many-electron interactions in solids; Sicily, Italy (Sep 1973).

The reflection of an incident low-energy ($10eV \leq E \leq 500eV$) electron by a solid is dominated by the consequences of its interactions with the valence electrons in the solid. The high probability that the incident electron suffers an inelastic electron–electron collision renders the elastic electron-solid scattering cross sections direct measures of the electronic structure and positions of ion cores within 10Å or less of the solid's surface. The major features of the coherent reflection are indicated, i.e., diffraction, of such low-energy electrons from planar surfaces of single-crystal solids and of current theoretical models of this phenomenon. Emphasis is placed on those features of the electron–electron and electron–ion–core interactions that permit the extraction of the atomic geometry of surface species from measured low-energy electron-diffraction ("LEED") intensities. Analysis of the elastic low-energy electron-diffraction intensities from the low-index faces of aluminum reveals the relatively modest influence on these intensities of the detailed shape of the one-electron optical potential and of the electronic structure of the ion cores. This result, in turn, is used to analyze the atomic structur of Ni(100)-c(2 × 2)-S, Ni(100)-c(2 × 2)-O and Cu(100)-c(2 × 2)-O absorbed overlayers. The status of applications of LEED-intensity analyses to determine the atomic geometry of periodic surface structures is indicated. (11 figures, 16 references) (auth)

7460 (SLA-73-6005) FAST-RESPONSE FOIL DISCONNECTOR. Andrezen, A. B.; Burtsev, V. A.; Dubovoi, L. V.; Nadgornaya, M. P.; Produvnov, A. B. (Nauchno Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Nov 1973. Translation of NIIEFA-T-161. 16p. Dep. NTIS $3.00.

A fast-response foil disconnector with artificial quartz as the heat-absorbing medium is described. Preliminary results of an investigation into the electric explosions of aluminum foil are given. The disconnector switched currents of up to 200 kA into a load having an inductance of ~250 nH within ~0.2 μsec. The voltage on the disconnector at the time of explosion of the foil reached 200 kV and the electric field strength 6 kV/cm. (auth)

7461 (STU-70-1650/U-1188) STRESS CORROSION OF ALLOYED STEELS IN ALKALINE SOLUTIONS. Alkaline Stress Corrosion Cracking of Alloyed Steels. Electrochemical Investigations. Dahlgren, T.; Dahl, L. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Oct 1971. 27p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.50.

Equipment for studying alkaline stress corrosion at high pressure and high temperature has been constructed. The equipment includes an Inconel coated autoclave with loading equipment, circulation system, and electro-chemical measuring instrumentation with Hg/HgO reference electrode. Polarization curves for 3Cr–0.5 Mo–, 13Cr–, 13Cr–Mo–V–, and 18Cr–8Ni–steels in 20 percent NaOH have been registered. The material 3Cr–0.5 Mo–steel has been carefully studied in 20 percent NaOH: polarization curves at 225° and the potential as a function of temperature in the interval 25 to 225°C have been registered. Introductory investigations of stress corrosion have been done. (SW)

7462 (TID-26476) COMPREHENSIVE REPORT OF THE WORK DONE UNDER CONTRACT AT(40-1)-3329 DURING THE YEARS 1970–1973. Bernheim, F.; Ottolenghi, A. (Duke Univ.,

Durham, N. C. (USA). Dept. of Physiology and Pharmacology). Nov 1973. 58p. Dep. NTIS $5.00.

During the past three years of the project the principal aims of the effort have been: (1) to establish the quantitative relationship between eosinophilic leukocytes and phospholipase B in all major areas of distribution of these cells; and (2) to develop procedures and approaches for studying the kinetics and regulatory mechanisms of the peripheral eosinophilic population. Both objectives have been accomplished and a number of related and new aspects of the problem have been brought to light. (auth)

7463 (TID-26484) TEMPERATURE DEPENDENCE OF THE CARRIER MEAN FREE PATH LENGTH IN TIN BY THE RADIO-FREQUENCY SIZE EFFECT. Hughes, G. P.; Merrill, J. R. (Dartmouth Coll., Hanover, N.H. (USA). Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-3175. 77p. Dep. NTIS $6.00.

Thesis. Submitted by J. R. Merrill.

The temperature dependence of carrier mean free path lengths in tin was measured by means of the amplitude dependence of the radio-frequency size effect on temperature. Data on the mean free path length for the temperatures from 2 to 8 K is presented as measured by extremal orbits. These measurements were made for calipers in the plane perpendicular to the [010] direction. The temperature-dependent part of the mean free path length was found to obey $1/l(T) = QT^{\alpha}$. Anisotropy in both Q and α was found. Much of the Fermi surface obeyed a T^3 law, but the exponent α for the fourth-zone hole surface varied from 4.5 to 5.6 depending on the caliper and the direction of the magnetic field. (auth)

7464 (TRG-Report-2401) DATA: ITS COLLECTION, REDUCTION, AND EVALUATION; AND STEM (SCANNING TRANSMISSION ELECTRON MICROSCOPY). Ferguson, I. F. (ed.). (UKAEA Reactor Group, Springfields). 1972. 115p. (CONF-721151-). Dep. NTIS (U. S. Sales Only) $7.75. Pounds £2.00.

From 20th UKAEA diffraction analysis meeting; Bournemouth, UK (16 Nov 1972).

The first part of the Conference dealt with data collection, reduction and evaluation methods, and their application to current diffraction problems related to atomic energy as encountered in X-ray fluorescence, SEM, high voltage electron microscopy, X-ray diffraction, optical microscopy and EMPA. The second part discusses Scanning Transmission Electron Microscopy (STEM) in terms of its promise, and the progress being made towards its commercial realization in the Vacuum Generators HB5 Scanning Transmission Electron Microscope. Of the 20 papers reported, 4 are in brief summary form only. (auth)

7465 (UCID-15677) NANOSECOND-PULSE HOLOGRAPHY. Chau, H. H.; Leppelmeier, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jul 1970. 13p. Dep. NTIS $3.00.

A single-mode ruby laser system is described that is suitable for use in pulsed holography (pulse width less than 10 nsec). A new definition is presented concerning the meaning of coherent length in a short-pulse laser. Photographs of the hologram-reconstructed images of various objects show the quality and stop-motion capability of the system. (auth)

7466 (UCID-16333) PROPAGATION OF ULTRASHORT LIGHT PULSES IN A LASER MEDIUM. Mishkin, E. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1973. Contract W-7405-Eng-48. 32p. Dep. NTIS $3.75.

The set of coupled Maxwell-Schroedinger equations that govern the propagation of ultrashort pulses through a nonlinear laser medium are solved analytically in the steady-state regime. The periodic energy exchange, between the intense passing electromagnetic field and the stationary aggregate of two level atoms, leads to doubly periodic Jacobian elliptic function solutions. Their modulus k is a function of the characteristic time length of the system τ and the pulse amplitude ξ_0. The physical properties of these steady-state solutions are considered. It is shown that there are, in essence, only four periodic pulse-train solutions sdu, ndu, cnu and dnu, u is the retarded time t-z/v referred to the characteristic time τ. τ and the length of the pulse T are controlled by the steady population inversion density η_0 established from the outside. Two of these solutions expand with intensified optical pumping while the other two contract under the same conditions. (auth)

7467 (UCID-16367) RESULTS FROM THE ONE BOX KINETICS TRANSPORT CODE. Walton, J. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Sep 1973. Contract W-7405-Eng-48. 16p. Dep. NTIS $3.00.

Preliminary results are presented from calculations concerning the kinetics and transport of a single SST exhaust plume. Curves are shown that exhibit the effect of different transport rates on axis ozone concentration and total ozone destruction per unit plume length. (auth)

7468 (UCLA-34-P-201-6) LATTICE WAVE DESCRIPTION OF METALLURGICAL PHASE TRANSFORMATIONS. de Fontaine, D. (California Univ., Los Angeles (USA). Dept. of Materials). 1973. 20p. Dep. NTIS $3.00.

An arbitrary disturbance in a crystalline solid solution is described as a sum of lattice plane wave modulations. In metallic systems, the wave amplitude generally refers to atomic displacements or to atomic replacements (the occupation of lattice sites or interstices by atoms or ions of various species). For example: displacive shear waves with k near the Brillouin zone center describe a martensitic phase transformation, displacive shear waves with $\vec{k} = \frac{1}{2}\langle 112\rangle$ (close to the Brillouin zone boundary) describe the omega phase transition, replacive waves with k near the BZ center describe spinodal decomposition, a replacive wave with A/B polarization and $\vec{k} = \langle 100\rangle$, and a replacive wave with AB/CC polarization and $\vec{k} = \frac{1}{2}\langle 111\rangle$ (BZ corners) describe β-brass and Heusler alloy order respectively in ABC_2 bcc ternary solid solutions. (auth)

7469 (UCLA-34-P-201-7) KINETICS OF ORDER–DISORDER. Fourth Topical Progress Report, January 1–December 31, 1973. Yamauchi, H.; de Fontaine, D. (California Univ., Los Angeles (USA). Dept. of Materials). 1973. Contract AT(04-3)-34. 31p. Dep. NTIS $3.75.

Various theoretical models of order–disorder kinetics are presented from a unified point of view. The time evolution of both single-site and pair-site probabilities is derived from a single master equation for the time dependence of configuration probabilities in binary solid solutions. Linearized diffusion equations are solved in the Fourier representation, and theoretical predictions are compared with experimental results of disordering kinetics in binary and ternary solid solutions. A nonlinear equation for long-range-order kinetics is also derived from the master equation, and compared with the classical theories of Dienes and of Vineyard and with experimental data. The phenomenon of critical slowing down and the kinetics of short-range order are briefly covered. (auth)

7470 (UCRL-13579) INVESTIGATION ON THE LOW-TEMPERATURE SPECIFIC HEAT OF FCC ALLOYS CHARGED WITH HYDROGEN. Annual Report, June 1, 1972–May 31, 1973. Massalski, T. B. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Metal Physics Lab.). 1973. Subcontract 8173409. 56p. Dep. NTIS $5.00.

For California Univ., Livermore. Lawrence Livermore Lab.

A literature review is presented on various models of H embrittlement of FCC metals. Information is reviewed on kinetic, thermodynamic, and mechanical aspects of these reactions. Information is included on Pd–H systems, Pd–Ag–H systems, and other transition metal–H systems. Experimental results of analyses of Pd–Au rods are also included. (JRD)

7471 (UCRL-13585) MULTIAXIAL TESTING OF DUCTILE AND BRITTLE SOLIDS. Final Report, September 1, 1971-September 30, 1973. Finnie, I.; Holt, N. L.; Saith, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1973. 63p. Dep. NTIS $5.25.

The possibility of using slotted specimens to obtain multiaxial data from uniaxial loads is considered. It was concluded that, while the specimen may have special uses, it is unlikely to be acceptable as a precise method for evaluating the flow curve of a ductile metal. The propagation of a crack under combined stress is treated. It is shown that transverse stresses have relatively little effect on fracture toughness. Some results in the literature on crack propagation under oblique loading are corrected, and a new criterion for the directional stability of a crack is proposed. It is shown that the assumptions used in developing strength theories for low-porosity compacts do not accurately represent the high-porosity case. A model is developed based on the compact being a collection of spherical particles rather than a material with spherical voids. Predictions are made for yield strength, ultimate strength, strain to failure, and fracture toughness assuming various packing arrangements. The predictions for ultimate strength are shown to be in good agreement with experiments and with values reported in the literature. (auth)

7472 (UR-3490-247) BIOLOGICAL EFFECTS AND EXPOSURE STANDARDS FOR NONIONIZING ELECTROMAGNETIC ENERGIES. Michaelson, S. M. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 13p. (CONF-730907-15). Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Nonionizing radiant energies at certain frequencies, intensities, and durations of exposure can produce biological effects which may be beneficial as well as harmful. For the general population and

those persons exposed or with potential for exposure to these energies, personnel exposure guidelines and product emission standards have been promulgated for some of these energies. Personnel protection guides or exposure standards are usually those established by the American National Standards Institute (ANSI), American Conference of Governmental Industrial Hygienists (ACGIH) or Department of Defense. Some industrial organizations have standards of their own which may be modifications of the national standards. Legislation for personnel exposure and product emission levels for NIR are covered under the Occupational Safety and Health Act of 1970 and the Radiation Control for Health and Safety Act of 1968, respectively. It is important that distinction be carefully made between product emission standards and personnel exposure standards and how they relate to potential injury. A proper perspective and realistic assessment of the biomedical effects of these radiant energies is essential so that the individual or general public will not be unduly exposed nor will research, development and beneficial utilization of these energies be hampered or restricted. (auth)

7473 (UR-3490-317) THERMAL EFFECTS OF SINGLE AND REPEATED EXPOSURES TO MICROWAVES. A Review. Michaelson, S. M. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 68p. (CONF-731042-1). Dep. NTIS $5.50.

From international symposium on biologic effects and health hazards of microwave radiation; Warsaw, Poland (15 Oct 1973).

7474 (WAPD-TM-1087) HYDRODYNAMIC MASS MATRIX FOR A MULTI-BODIED SYSTEM. Sharp, G. R.; Wenzel, W. A. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Sep 1973. Contract AT(36-1)-GEN-14. 61p. Dep. NTIS $5.25.

A matrix technique is developed herein for generating the hydrodynamic mass matrix associated with a multi-mass system immersed in a liquid environment. The technique assumes that the liquid environment may be represented by a series of flow-channels and nodes. Flow channels are introduced in the region between surfaces of neighboring solids, and nodes are used to connect two or more flow channels. It is assumed that the solid bodies undergo unidirectional motion and that potential flow theory is applicable. Equations for fluid flow in a variable area flow channel are obtained by first developing the governing equations for fluid flow in a channel bounded by two parallel surfaces that may move in translation both perpendicular and parallel to the direction of flow. The continuity equation is then developed for an arbitrary node, and the general matrix equation for computing hydrodynamic mass is obtained by applying the developed equations to a particular problem. A computer program was written in FORTRAN-IV for use in evaluating this matrix expression. Its input description is presented in an appendix. The resulting matrix equation and computer program was used to determine the hydrodynamic mass of a cylinder within a cylinder having a fluid connecting region. A comparison of the results with the closed-form solution obtained from potential theory provided a means for assessing the accuracy of the technique. (auth)

7475 (Y-DJ-8089) ADVANTAGE OF USING MULTIVARIATE TOLERANCE REGIONS FOR THE CERTIFICATION OF RELATED CHARACTERISTICS. Holland, C. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1973. Contract W-7405-eng-26. 6p. (CONF-731029-2). Dep. NTIS $3.00.

From southeastern regional meeting, the Institute of Management Science; Atlanta, Georgia, USA (18 Oct 1973).

Multivariate tolerance regions offer two primary advantages over univariate tolerance intervals in the certification of related characteristics. The first advantage is that with the multivariate tolerance regions probability statements can be made about the entire set of required characteristics rather than each characteristic separately. The second advantage is that with the multivariate tolerance regions the relationships among the variables are controlled as well as the means and variances. (auth)

7476 CONTACT TOOL SETTER (ENGINEERING MATERIALS). (Oak Ridge Y-12 Plant, Tenn. (USA)). (CAPE-2370).

6 Drawings.

By taking advantage of the submicrometer resolution of state-of-the-art numerical control, a low-pressure contact tool setter has been developed that has a resolution of ±10 microinches (±0.254 μm). The tool setter was designed to be incorporated into numerically controlled turning machines using machine tool reference-point operations and automatic tool-setting control. The tool setter has at least three features desirable for contemporary setting, namely: (1) very little maintenance, (2) low cost, and (3) adaptivity to machines using pedestal-type tool-setting stations. (See also Y-1885) (auth)

7477 MCS-8 CONTROL PROCESSOR (MAY 1973) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2367).

14 drawings.

7478 EIGHT BIT CENTRAL PROCESSOR (30 AUG 1973) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2369).

22 drawings.

The MCS-8 Microcomputer is an Intel Corporation 8008 Central Processor Integrated Circuit, interfaced with LLL-designed control logic which provides experimenters with a complete, low-cost (~ $500.00) digital computer system. The system has erasable and reprogrammable fixed memory for a set of 48 instructions, and up to 16k 8-bit words of total memory. Applications include the control of fabrication processes, numerically operated machinery, printers, plotters and keyboards. The MCS-8 can also be used as a logic element; such use can significantly reduce the amount of combinational logic required in a system. (auth)

7479 PROCEEDINGS OF THE SAN DIEGO BIOMEDICAL SYMPOSIUM, SAN DIEGO, CALIFORNIA, JANUARY 31–FEBRUARY 2, 1973. Volume 12. San Diego, CA; San Diego Biomedical Symposium (1973). 347p. (CONF-730122-). $20.00.

Sixty papers discuss new procedures and equipment for use in clinical diagnosis or patient care. Emphasis is placed on remote monitoring of patients and use of computers in diagnosis. (CH)

7480 PROCEEDINGS OF THE SAN DIEGO BIOMEDICAL SYMPOSIUM, SAN DIEGO, CALIFORNIA, FEBRUARY 2–4, 1972. Volume 11. San Diego, CA; San Diego Biomedical Symposium (1972). 410p. (CONF-720230-). $20.00.

Fifty-five papers discuss new procedures and equipment for use in clinical diagnosis or patient care. Emphasis is placed on the use of television equipment and computer techniques. (CH)

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Reactor Shielding for Nuclear Engineers

By N. M. Schaeffer
Radiation Research Associates, Inc.

Prepared for the Division of Reactor Development and Technology, USAEC, and published by the Office of Information Services, USAEC

As the number of nuclear power plants on order continues to grow (currently more than thirty per year in the United States alone), the demand for nuclear engineers should also increase, and a new text on reactor shielding is overdue. Shielding technology has matured considerably in the last decade, and shield physics must routinely be translated into shield design. Since the publication in 1959 of *Fundamental Aspects of Reactor Shielding,* by Herbert Goldstein, new generations of computers have become available to exploit techniques heretofore considered too costly, and new measurement techniques have been devised. The energy and angular distributions of neutrons and gamma rays can be followed, both in theory and in practice, throughout their transport histories. Such powerful tools have brought correspondingly large dividends to the shielding community.

These advances and their underlying fundamentals are recorded in this volume, which is intended as a text for a two-semester course in reactor shielding directed at an advanced-undergraduate or a graduate level. (800 pages; 7 by 10 inches; Library of Congress Catalog Card Number 73-600001)

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